Savannah River Site
Solid Waste Management Department
Consolidated Incinerator Facility
Operator Training Program

CONSOLIDATED INCINERATOR FACILITY (CIF) AQUEOUS WASTE SYSTEM (U)

Study Guide

ZIOITX12

Revision 02

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Training Manager / Date

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Engineering Manager / Date

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Facility Manager / Date

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REVISION LOG

REV.	AFFECTED SECTION(S)	SUMMARY OF CHANGE
02	All	New Issue

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

REFERENCES

1. Drawing W830310, *SRS Bldg. 262-H Area 200-H Aqueous Waste Tank Process Serv. PPG & Inst Diag Process and Instruments* (U), Rev. 64 Sheets 1 and 2 of 2

2. Drawing W835590, *SRS Bldg. 261-H Area 200-H RK Aqueous Waste Nozzle Pwr. Serv. PPG. & Instr. Diag. Power and Instruments* (U), Rev. 16

3. Drawing W835635, *SRS Bldg. 261-H Area 200-H RK Aqueous Waste Feed Pump Power Piping & Instr Diag. Power & Instruments*, Rev. 4

4. Drawing SE5-2-2006178, *CIF Tank Farm Logic Diagram Sheet 4 Instruments*, Rev. 1

5. Drawing SE5-2006263, *CIF Tank Farm Logic Diagram Sheet 17 Instruments*, Rev. 1

6. Drawing W2017835, *CIF Tank Farm Logic Diagram Sheet 22 Instruments*, Rev. 1

7. Drawing W2017836, *CIF Tank Farm Logic Diagram Sheet 23 Instruments*, Rev. 1

8. Drawing W2017837, *CIF Tank Farm Logic Diagram Sheet 24 Instruments*, Rev. 1

9. J-JX-H-0020, *Device Setpoint/Acceptance Criteria*, Rev. 2

10. WSRC-SA-17, *Consolidated Incinerator Facility Safety Analysis Report*, Rev. 0

11. ZIOISX12, Aqueous Waste System Design Description

LEARNING OBJECTIVES

TERMINAL OBJECTIVE

1.00 Given the necessary procedures, **OPERATE** the Aqueous Waste System to support the safe, efficient operation on the Consolidated Incinerator Facility (CIF).

ENABLING LEARNING OBJECTIVES

1.01 **STATE** the purpose of the CIF Aqueous Waste (AQW) System.

1.02 Briefly **DESCRIBE** how the AQW System accomplishes its purpose.

TERMINAL OBJECTIVE

2.00 Using the system diagrams, **EVALUATE** potential problems which could interfere with normal Aqueous Waste System flowpaths to determine their significance on overall system operation and the corrective actions needed to return the system to normal.

ENABLING LEARNING OBJECTIVES

2.01 **DESCRIBE** the layout of the Aqueous Waste System components including the general location, and functional relationship of the following major components:

a. AQW Tank
b. AQW Tank Agitator
c. AQW Tank Transfer Pump
d. AQW Feed Pump
e. AQW Nozzle
f. AQW Remote Skid
g. RK Burner Skids
h. Pneumatically operated valves

2.02 **DESCRIBE** the Aqueous Waste System arrangement, to include a drawing showing the following system flowpaths/interfaces with other systems:

a. Aqueous Waste Tank
b. Aqueous Waste Transfer Pump
c. Flow Transmitters
d. Interfaces with supporting systems
e. All flow paths to and from the AQW Tank
f. AQW Feed Pump flow path

2.03 **STATE** the normal operating condition for the following major components:

a. AQW Tank
b. AQW Tank Agitator
c. AQW Tank Transfer Pump
d. AQW Feed Pump
e. AQW Nozzle

2.04 Given a description of abnormal equipment status for the Aqueous Waste System, **EXPLAIN** the significance of the condition on the system operation.

TERMINAL OBJECTIVE

3.00 Given values of Aqueous Waste System operating parameters , **EVALUATE** potential problems that could effect the normal functioning of the system or its components to determine the significance of the existing condition and the actions required to return the system to normal operation.

ENABLING LEARNING OBJECTIVES

3.01 **DESCRIBE** the following major components of the Aqueous Waste System including their functions, principles of operation and basic construction:

a. AQW Tank
b. AQW Tank Agitator
c. AQW Tank Transfer Pump
d. AQW Feed Pump
e. AQW Nozzle

3.02 **DETERMINE** the operational limitations for the following Aqueous Waste System major components:

a. AQW Tank
b. AQW Tank Agitator
c. AQW Tank Transfer Pump
d. AQW Feed Pump

3.03 **IDENTIFY** the key performance indicators used to verify correct operation of the following Aqueous Waste System components:

a. AQW Tank
b. AQW Tank Agitator
c. AQW Tank Transfer Pump
d. AQW Feed Pump

3.04 Given values for key performance indicators, **DETERMINE** if the following Aqueous Waste System components are functioning as expected:

a. Level transmitter
b. Specific gravity transmitter
c. AQW Tank temperature
d. AQW Tank Nitrogen Pressure
e. AQW Pressure
f. AQW Steam Pressure
g. AQW Transfer Flow

3.05 **INTERPRET** the following Aqueous Waste System alarms, to include the conditions causing alarm actuation and the basis for the alarm:

a. Level alarms
b. Temperature alarms
c. Tank pressure alarms
d. Differential pressure alarms
e. Corrosion alarms
f. Flow alarms
g. System pressure alarms

3.06 **DESCRIBE** the following Aqueous Waste System instrumentation including indicator location (local or Control Room), sensing points, instrument types, failure modes, and associated instrument controls:

a. Level transmitter
b. Specific gravity transmitter
c. AQW Tank temperature
d. Corrosion Transmitters
e. AQW Tank Nitrogen Pressure
f. AQW Pressure
g. AQW Steam Pressure
h. AQW Transfer Flow

3.07 **EXPLAIN** how the following Aqueous Waste System equipment is controlled in all operating modes or conditions to include control locations (local or control room), basic operating principles of control devices, and the effects of each control on the component operation:

a. AQW Transfer Pump
b. AQW Feed Pump
c. AQW Transfer Switch
d. AQW Tank Agitator

e. AQW Feed Controller

f. AQW Transfer Controller

3.08 **DESCRIBE** the interlocks associated with the following Aqueous Waste System equipment to include the interlock actuating conditions, effects of interlock actuation, and the reason the interlock is necessary:

a. AQW Transfer Pump

b. AQW Feed Pump

c. AQW agitator

d. AQW transfer pump discharge valves

3.09 **DESCRIBE** the operational interrelationships between the Aqueous Waste System and the following support systems, to include the effects of a failure of the supporting system and the effects of an improper alignment between the systems:

a. DCS

b. Heat Trace System

c. Electrical Distribution System

d. Instrument Air System

e. Nitrogen System

f. Waste Vent System

TERMINAL OBJECTIVE

4.00 Given the necessary procedures or other technical documents and system conditions, **DETERMINE** the operator actions required for normal and abnormal operation of the Aqueous Waste System including problem recognition and resolution.

ENABLING LEARNING OBJECTIVES

4.01 **IDENTIFY** the key performance indicators used to predict or verify normal operation of the Aqueous Waste System.

4.02 **DETERMINE** the effects on the Aqueous Waste System and the integrated plant response when given any of the following:

a. Indications/alarms

b. Malfunctions/failure of components

c. Operator actions

4.03 Given the applicable procedures and plant conditions, **DETERMINE** the actions necessary to perform the following Aqueous Waste System operations:

a. Aqueous Waste Tank recirculation and sampling

b. Establishing Aqueous Waste Tank recirculation to the Aqueous Waste Feed

Pump

c. Aqueous Waste Transfer to Blend Tank #1 or #2

d. Aqueous Waste Transfer to the Spare Tank

SYSTEM OVERVIEW

Safety

The waste storage tanks in the CIF are designed, fabricated, installed, tested and operated in accordance with recognized industry codes, standards, and QA programs. Compliance with codes, standards and QA programs coupled with redundant features for important equipment and Instrumentation and Control system components; assure that the functional requirements of the Liquid Waste Handling System are met.

Materials for all pumps and hoses are compatible with the liquids to be handled. Pipe fittings and valves are selected based on compatibility with the liquid waste to be processed. The operating pressures and/or the maximum pressure capability of the pumps are well within the pressure rating of the pipe. Recirculation orifices are installed on the discharge lines of the centrifugal pumps to prevent these pumps from discharging against a closed header. In each instance, the orifice recirculation lines discharge back into the tanks from which the liquid waste originated.

The waste tanks are equipped with a rupture disc to protect the tanks from excessive internal positive pressure. The rupture discs are designed to break at +1.5 psig. If the disc breaks, a visual and audible alarm is activated in the control room. The waste tanks are also equipped with a loop seal that will collapse if the internal pressure drops to -2.4 psig. No alarm is provided on the loop seal. However, if the pressure in the tank drops below 0 inwc, a visual and audible alarm is activated in the Control Room. There is no safety class equipment associated with tank farm operations.

Differential pressure switches are installed to detect an excessive pressure drop across filters and strainers. An excessive pressure drop across these items actuates a visual and audible alarm in the Control Room.

The following systems or components contribute to safe operations in the Tank Farm.

- Nitrogen blanketing of waste tanks
- Tank Vent Systems
- Pump Seal Systems
- Combustible Gas Detectors
- Fire Suppression System
- Waste tank rupture discs

Take precautions to avoid uncontrolled releases to the environment or contamination of personnel. Radiation Control Operations (RCO) personnel and your supervisor should be notified if spills occur.

The transfer of Aqueous Waste between tanks in the Tank Farm shall be stopped when a tank farm area combustible gas detector or radiation detector alarms.

Recirculation or processing of aqueous waste to the remote and local burner skids shall be stopped when a tank farm or rotary kiln area combustible gas detector or radiation detector alarms.

The aqueous waste Tank agitator must remain in operation when liquid is in the tank and outside temperatures are below freezing. Agitation prevents freezing of the tank contents.

Introduction

The Aqueous Waste (AQW) System consists of a storage tank, transfer pump, feed pump, Incinerator Nozzle, and associated piping and valves. Aqueous wastes are those wastes generated at the CIF and other on site facilities with a low heating value. These wastes are typically water-based, hence the name "Aqueous". Aqueous Waste is also generated from various CIF sumps if the liquid does not meet the requirements for pumping to the outfall.

AQW from other site facilities typically arrives at the CIF Regulated Unloading Area in 1000-gallon portable tanks. It may also be delivered in other size tanks or tankers. The Rad Oils/Solvents Unloading (Rad Oils) System is used to transfer the contents of the transport vessel to the AQW Tank. All waste arriving at the CIF must meet the waste acceptance criteria.

It is important to understand that the aqueous waste injected into the incinerator via the aqueous waste nozzle is much more likely to evaporate than to actually burn. Combustion is unlikely since the heat content of the material is kept low (< 5000 Btu by procedure). Efforts should be made to maintain the heat value of the Aqueous Waste as low as possible. Consideration should be given to transferring Aqueous Waste to a Blend Tank if heating values approach 5000 Btu. Any particulates suspended in the liquid will be incinerated, and combustible components will burn.

SYSTEM PURPOSE

1.01 STATE the purpose of the CIF Aqueous Waste System (AQW).

Aqueous Waste System Purpose

The purpose of the AQW System is to store and transfer aqueous waste. The sources of aqueous waste and transfer points are listed below.

The AQW Storage Tank can receive waste from the following sources:

- Rad. Oils/Solvents Unloading System
- Spare Tank Transfer Pump
- Incineration building sump pumps
- Clean sump pump
- Regulated sump pump
- Automatic Sampler
- Process Water System

The AQW Tank can be pumped to the following components:

- AQW Feed Pump
- Blend Waste Tank # 1 or #2
- Spare Tank
- Automatic Sampler

DESCRIPTION AND FLOWPATH

1.02	**Briefly DESCRIBE how the Aqueous Waste System accomplishes its purpose.**
2.01	**DESCRIBE the physical layout of the Aqueous Waste System components including the general location, how many there are, and functional relationship of major components.** **a. AQW Tank** **b. AQW Tank Agitator** **c. AQW Tank Transfer Pump** **d. AQW Feed Pump** **e. AQW Nozzle** **f. AQW Remote Skid** **g. RK Burner Skids** **h. Pneumatically operated valves**
2.02	**DESCRIBE the Aqueous Waste System arrangement, to include a drawing showing system flowpaths/interfaces with other systems.** **a. Aqueous Waste Tank** **b. Aqueous Waste Transfer Pump** **c. Flow Transmitters** **d. Interfaces with supporting systems** **e. All flow paths to and from the AQW Tank** **f. AQW Feed Pump flow path**

Aqueous Waste System Description and Flowpath

System Description

The AQW System consists of a nominal 6500 gallon tank, transfer pump, feed pump, filter, flow transmitters, valves and piping. The components are located in the tank farm, the remote AQW skid, and on local and remote RK burner skids.

The purpose of the AQW Tank is to provide a holding and mixing volume for the aqueous waste. A tank agitator is provided to keep waste solids suspended in solution. Once an adequate suspension has been achieved, the waste is sampled to determine the organic content from which the heating value can be calculated. If the heating value is ≤ 5000 Btu/lb and the specific gravity is ≤ 1.05, it can be pumped by the Aqueous Waste Transfer Pump to the Aqueous Waste Feed Pump which delivers it to the RK AQW Nozzle for evaporation in the Rotary Kiln.

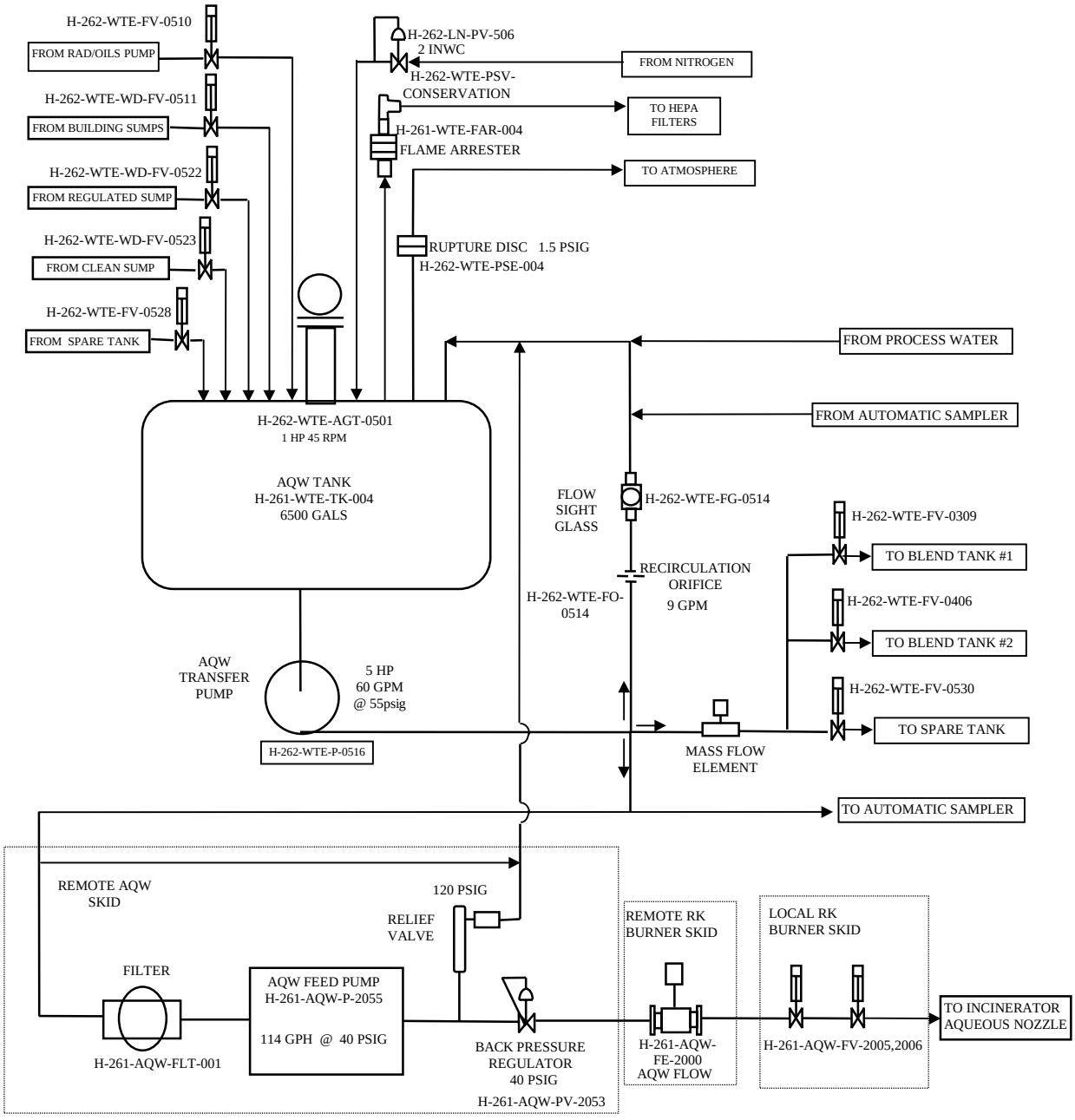


Figure 1 Aqueous Waste System Simplified Diagram

Process water can be added to the tank to reduce heating value and/or specific gravity as determined by the Chemistry Coordinator. The AQW Tank also serves as part of the spill containment and collection system. The clean and regulated sump pumps direct contaminated spilled liquids to the aqueous waste tank through a duplex strainer. Uncontaminated rainwater or washdown can be pumped to the outfall.

The Aqueous Waste Transfer Pump is a centrifugal pump capable of handling paint and sump solids expected to be present in the AQW Tank. The transfer pump is provided with a sealing system to prevent leakage of waste from the mechanical seals. The clean sweep filter located in the suction line to the AQW feed pump is used to prevent blockage of the aqueous waste nozzle by waste solids. The AQW tank contains level, pressure, and temperature monitoring equipment to provide indications, alarms and control functions necessary for the safe operation of the system. The aqueous waste feed pump is a high performance diaphragm metering pump controlled from the DCS. The flow-rate of the pump is adjusted by varying the stroke of the pump plunger. The feed flow is atomized with 120 lb steam as it is injected through the AQW nozzle into the RK for evaporation. Cooling steam flow to the AQW nozzle is initiated when the RK temperature exceeds 1000°F, to provide nozzle cooling. Figure 1, *Aqueous Waste Tank Simplified Diagram,* illustrates the flowpaths within the AQW System and interfacing with other waste or supporting systems.

Flowpaths From the Aqueous Waste System

The AQW transfer pump can provide flow to six (6) locations. A basic description of these flowpaths is given below:

Flowpath to the Incinerator

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the components in the basic flowpath between the AQW tank and the incinerator. The discharge of the Aqueous Waste Transfer Pump is directed to the suction of the aqueous waste feed pump through a filter. The excess flow is recirculated back to the AQW Tank. The transfer pump is capable of moving 60 gpm to the feed lines and the maximum AQW feed flow is 950 lb/hr or 1.9 gpm. Normally AQW feed flow is less than 950 lb/hr. The remaining flow is recirculated back to the AQW tank. The feed pump discharges through a backpressure regulator located along with the feed pump on the remote AQW skid. Flow continues to the flow transmitter located on the remote RK burner skid. The Safety Shut Off Valves located on the local RK burner skid isolate flow to the AQW nozzle.

Flowpath to Blend Tank #1 and #2

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the components in the basic flowpath between the AQW Tank and the Blend tanks. The discharge of the Aqueous Waste Transfer Pump is directed through the Mass Flow Transmitter and on to the selected Blend Tank through air-operated flow isolation valves H-262-WTE-FV-0309 for Blend Tank #1, and H-262-WTE-FV-0406 for Blend Tank #2.

Flowpath to the Spare Tank

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the components in the basic flowpath between the AQW tank and the Spare Tank. The discharge of the Aqueous Waste Transfer Pump is directed through the Mass Flow Transmitter and on to the Spare Tank through air-operated flow isolation valve H-262-WTE-FV-0530.

Sample Flowpath

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the components in the basic flowpath between the AQW tank and the Automatic Sampling System. The Automatic Sampling System receives flow from the discharge of the AQW Transfer Pump by manual valve manipulation. The return flow from the Automatic Sampler is directed to the AQW Tank.

Recirculation Flowpath

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the components in the basic flowpath for recirculation of AQW tank contents. The AQW Transfer Pump discharge contents is directed through the recirculation orifice and a sight flow indicator. The flow returns to the tank. The recirculation orifice limits the flow rate to 10 gallons per minute. This flowpath is used when recirculating the tank contents prior to sampling the tank. Recirculation flow also exists between the AQW transfer pump and the AQW feed pump bypass line. The bypass line returns to the AQW tank. The total recirculation flow would be 60 gpm or 3600 gallons per hour.

Flowpaths To the Aqueous Waste System

The Aqueous Waste Tank can receive waste flow from five (5) different sources. The flowpaths are interlocked to prevent having flow from more than one source at a time. Also, flow can not go into the tank at the same time as flow is coming out of the tank. These flow paths are briefly described below:

Flowpath from the Clean Sump Pump

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the AQW Tank interface with the Clean Sump Pump. Flow from the Clean Sump Pump must flow through Clean Sump Pump to AQW Tank valve H-262-WD-FV-0523.

Flowpath from the Spare Tank

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the AQW tank interface with the Spare Tank. Flow from the Spare Tank Transfer Pump must flow through Spare Tank to AQW Tank valve H-262-WD-FV-0528.

Flowpath from the Rad./Oils Solvents Unloading Pump

Figure 1, *Aqueous Waste System Simplified Diagram,* illustrates the AQW tank interface with

the Rad Oils/Solvents Unloading Pump. Flow from the unloading pump must flow through Rad Oils/Solvents Unloading to AQW tank valve H-262-WD-FV-0510.

Flowpath from the Regulated Sump Pump

Figure 1, *Aqueous Waste System Simplified Diagram*, illustrates the AQW tank interface with the Regulated Sump Pump. Flow from Regulated Sump Pump must flow through a strainer and Regulated Sump Pump to AQW Tank valve H-262-WD-FV-0522.

Flowpath from the Building Sump Pump System

Figure 1, *Aqueous Waste System Simplified Diagram*, illustrates the AQW Tank interface with the building sumps. Flow from either one of three (3) Building Sump Pumps, a Stack Sump Pump, or an Off Gas Sump Pump discharges through a strainer and Building Sumps to AQW Tank valve H-262-WD-FV-0511.

MAJOR COMPONENTS

2.03	**STATE the normal operating condition for the following major components:** **a. AQW Tank** **b. AQW Tank Agitator** **c. AQW Tank Transfer Pump** **d. AQW Feed Pump** **e. AQW Nozzle**
2.04	**Given a description of abnormal equipment status for the Aqueous Waste System, EXPLAIN the significance of the condition on the system operation.**
3.01	**DESCRIBE the following major components of the Aqueous Waste System including their functions, principles of operation and basic construction:** **a. AQW Tank** **b. AQW Tank Agitator** **c. AQW Tank Transfer Pump** **d. AQW Feed Pump** **e. AQW Nozzle**
3.02	**STATE the design capacities and operational limitations for the following Aqueous Waste System major components:** **a. AQW Tank** **b. AQW Tank Agitator** **c. AQW Tank Transfer Pump** **d. AQW Feed Pump**
3.03	**IDENTIFY the key performance indicators used to verify correct operation of the following Aqueous Waste System components:** **a. AQW Tank** **b. AQW Tank Agitator** **c. AQW Tank Transfer Pump** **d. AQW Feed Pump**

3.04	**Given values for key performance indicators, DETERMINE if the Aqueous Waste System components are functioning as expected:** **a. Level transmitter** **b. Specific gravity transmitter** **c. AQW Tank temperature** **d. AQW Tank Nitrogen Pressure** **e. AQW Pressure** **f. AQW Steam Pressure** **g. AQW Transfer Flow**

AQW Tank

The AQW Tank is a 3/8″carbon steel vessel with a capacity of 6500 gallons. The tank is 10 feet in diameter and approximately 14 ½ feet tall. The AQW Tank is located at the eastern end of the regulated diked area of the Tank Farm as shown on Figure 2, *Tank Farm Layout*.

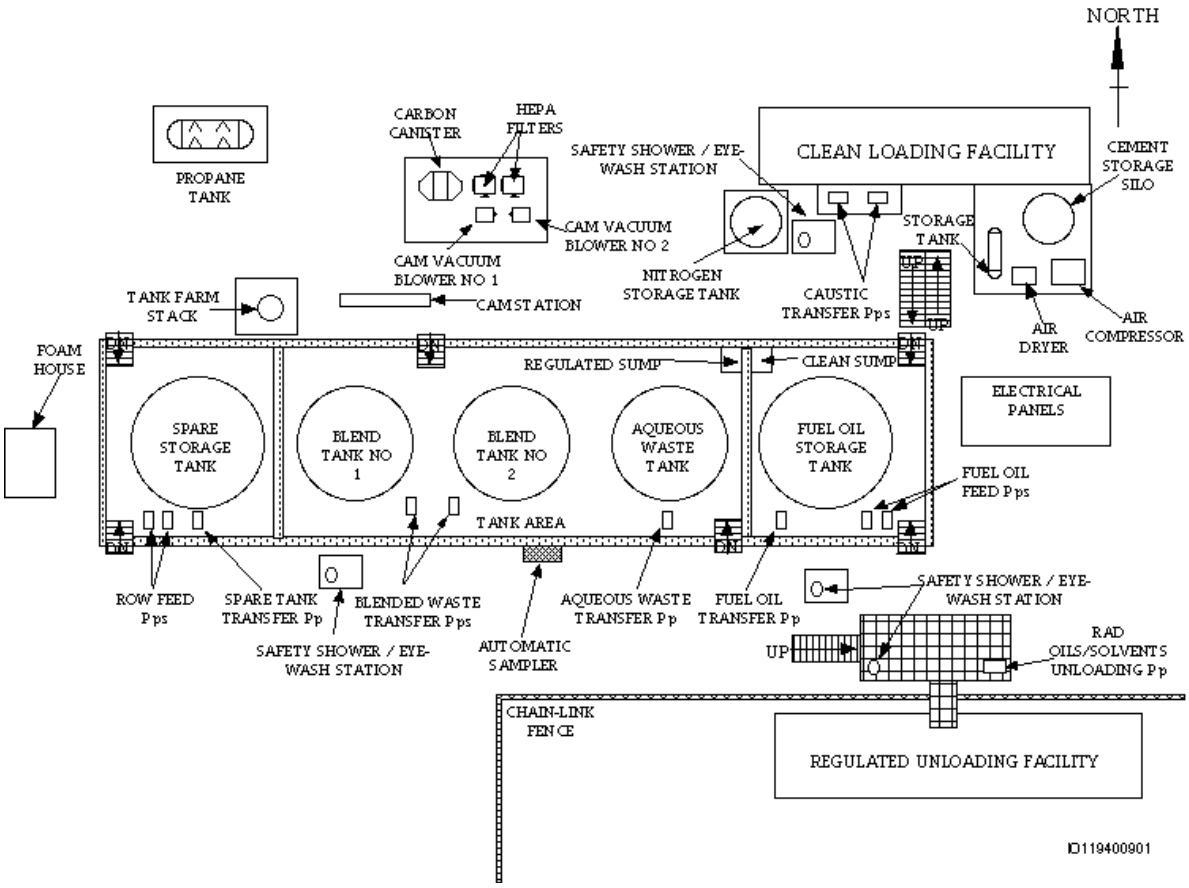


Figure 2 Tank Farm Layout

The AQW Tank is designed for a positive pressure of 10 psig plus static head and 2.5 psig negative pressure, (5.09 inches of mercury partial vacuum), at 200°F. The tank has been hydrostatically tested at 15 psig for one (1) hour. The tank legs are protected with 3-hour NFPA fireproofing.

Four (4) baffles, measuring 10 ft. 1½ inches high by 10 inches wide by 3/8 inches thick, are mounted inside the tank 90° apart.

The tank is provided with over-pressure and vacuum protection to ensure that the tank does not exceed design pressures. Over-pressure protection is provided by an eight (8) inch rupture disc designed to burst at 1.5 psig positive pressure and withstand 2.5 psig negative pressure. Figure 3, *AQW Tank Operating Pressures*, illustrates the sequence of events on changing tank pressures.

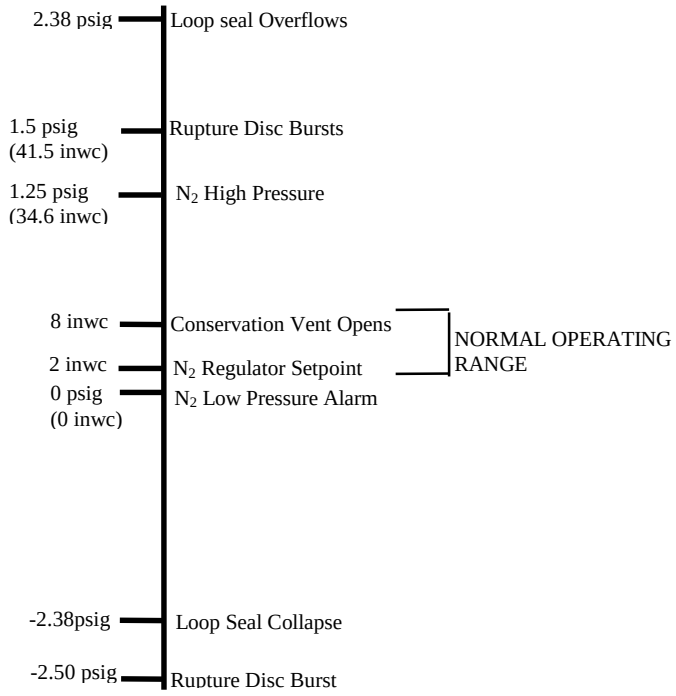


Figure 3 AQW Tank Operating Pressures

The tank is equipped with a loop seal as shown on Figure 4, *Loop Seal System*. The loop seal works in conjunction with the rupture disk to provide over-pressure and vacuum protection to the AQW Tank. The loop seal is designed to cause the rupture disc to break on positive pressure before it overflows and to "collapse" on partial vacuum before the rupture disc breaks. The loop seal will overflow at 2.38 psig positive pressure and the rupture disc will burst at 1.5 psig. This prevents overflowing of tank contents due to high pressures in the tank. Accordingly the rupture disc will rupture prior to the loop seal overflowing. The rupture disc will also burst at a negative pressure of 2.5 psig (5.09 inches of mercury partial vacuum) and the loop seal will "collapse" at a negative pressure of 2.38 psig (4.85 inches of mercury partial vacuum). "Collapsing" the loop seal permits air to bubble through the loop seal lines into the tank before the rupture disc bursts on negative pressure. The collapsing of the loop seal means that a fluid boundary is no longer present between the tank contents and atmosphere. The loop seal must be refilled to establish a

seal between tank gases and atmosphere. The loop seal is filled with a 50%-50% ethylene glycol-water solution. The loop is filled from a charging connection to a level in the sight glass of 30 3/8″ above loop centerline with the tank at atmospheric pressure.

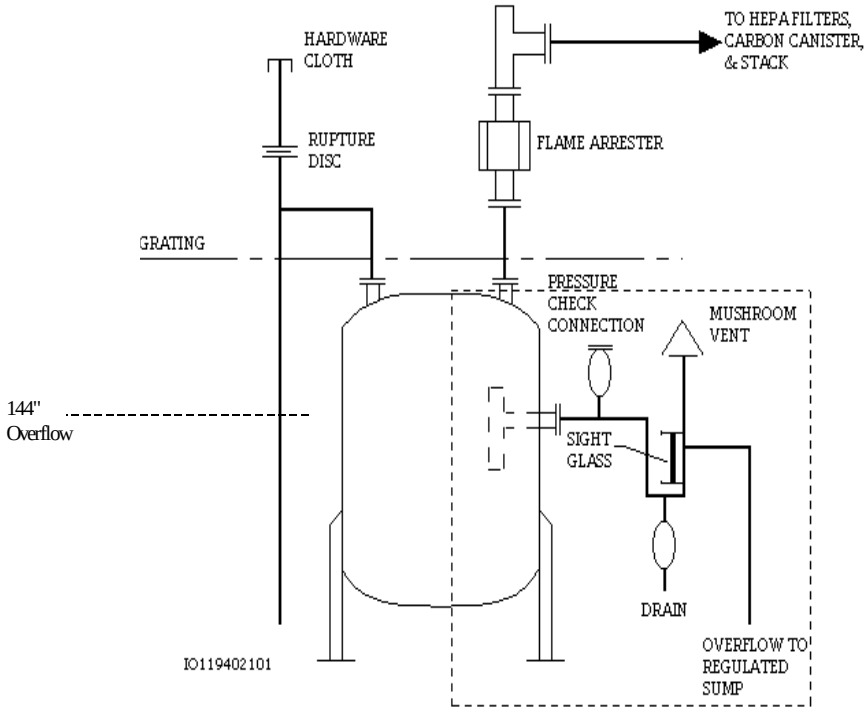


Figure 4 Loop Seal System

A “collapse” of the loop seal will not be indicated by the DCS, however if the nitrogen pressure in the tank drops below 0 INWC an alarm (H-262-WTE-PSL-0500) will be actuated in the DCS indicating a problem. Additionally a sight glass is provided in the loop seal to indicate the fluid level in the seal. Normal nitrogen pressure in the tank is maintained at 2 INWC by the nitrogen regulator. A nitrogen conservation vent is installed down stream of a flame arrester. The vent is designed to automatically open a weighted flapper valve at a tank pressure of 8 inwc. Opening of the vent relieves tank pressure to the Waste Vent System consisting of HEPA filters, Carbon Canisters and a stack. Care should be exercised when operating a tank vent system to prevent isolation of the vent lines. Isolation of Vent piping can lead to overpressurizing of the tank and rupture disc bursting. The flame arrester installed in the vent line prevents any flames that may occur in the downstream vent piping from entering the tank. The normal operating band is between 2 and 8 inwc, which is between the nitrogen regulator setpoint and the conservation vent operating setpoint.

If the rupture disc bursts as a result of high pressure there will also be an associated High-High N_2 Pressure (H-262-WTE-PAHH-0518) alarm at DCS point tag WRE0518PA-1. The rupture disc vent stack extends eight (8) feet above the platform and vents directly to atmosphere. A stainless steel wire cloth is mounted to the top of the stack to prevent the entrance of foreign material into the vent. The vent stack is provided with a drain at the bottom of the vent to remove rainwater.

AQW Tank Agitator

Figure 5, *AQW Tank Agitator Assembly,* illustrates the agitator with two 32-inch diameter blade assemblies and one twenty four (24) inch diameter blade assembly is mounted inside the tank. Rotation of the blades mix the contents of the AQW tank and prevents heavy solids from settling to the bottom of the tank.

Figure 5 AQW Tank Agitator Assembly

The agitator is operated whenever required by procedure and also to prevent freezing of the tank contents since the tank is not equipped with immersion heaters or heat trace. The blade assemblies are mounted on a common shaft that rotates at 45 rpm by an external, top- mounted 1 hp, three-phase, explosion-proof electric motor. The motor drives the blade shaft through a 25:1 reducer. The DCS controlled motor is powered from MCC 3, and can be locally operated from the MOA station located on the north side of the AQW Tank. The lower 24″ diameter blade assembly is spaced 6″ from the bottom of the tank. A 32″ blade assembly is mounted 36″ above the tank bottom and the remaining 32″ blade assembly is mounted 48″ above that. The Low-Low-Low Tank level will automatically cause the agitator to stop. This is to prevent uncovering the lower blade assembly containing the stabilizer. The stabilizer evenly distributes the forces of the blades to the shaft assembly. The assembly is nor designed to operate "dry". Wobbling of the shaft would result under this condition and place abnormal stresses on the shaft packing at the top of the tank.

AQW Tank Transfer Pump

The AQW Tank Transfer Pump is a horizontal, centrifugal pump with double mechanical seals and a forced circulation barrier fluid system. The transfer pump is designed for 60 gpm at 113 ft. total dynamic head (TDH). The pump is driven by 5 hp, explosion proof motor. Electrical power to the pump is supplied from MCC 3. The pump is normally DCS controlled, but can be locally operated from the control station on the south side of the AQW Tank.

The pump and its associated motor is mounted on a drip rim baseplate. A pump casing drain and a baseplate drain are provided. The drains are piped to the drainage trench in the regulated portion of the Tank Farm Diked Area. The pump is located on a pedestal in the center section of the Tank Farm Diked Area as shown on Figure 3, *Tank Farm Layout.*

The Pump Seal System illustrated in figure 5, *Pump Seal System*, uses a 50-50 mixture of water and ethylene glycol as a barrier solution. The thermosiphon system, as it is often referred to allows circulation of the barrier fluid to lubricate and cool the pump mechanical seals and also to prevent process fluids from leaking to the environment.

This solution is contained within a two-gallon capacity reservoir located near the associated pump. The reservoir serves as a surge volume for the system and is equipped with pressure and level sensing instruments. A low level H-262-WTE-PSL-5556, or low pressure H-262-WTE-LSL-5556 in the tank will cause the transfer pump to shut off if operating and prevent the pump from starting until the level or pressure condition is restored to normal. This automatic function is independent of the DCS, it is hardwired directly in the master controller for the pump motor.

The reservoir is filled by a manually operated hand pump. Barrier fluid level is indicated by sightglass on the side of the tank. After filling, the tank it is pressurized with nitrogen to provide sealing pressure to the pump seals. Pressure is normally maintained between 22-27 psig and nominal barrier fluid level in the reservoir is midpoint ±1 inch. Local indication of barrier fluid pressure and temperature is provided. This type of system is installed on all tank farm centrifugal pumps.

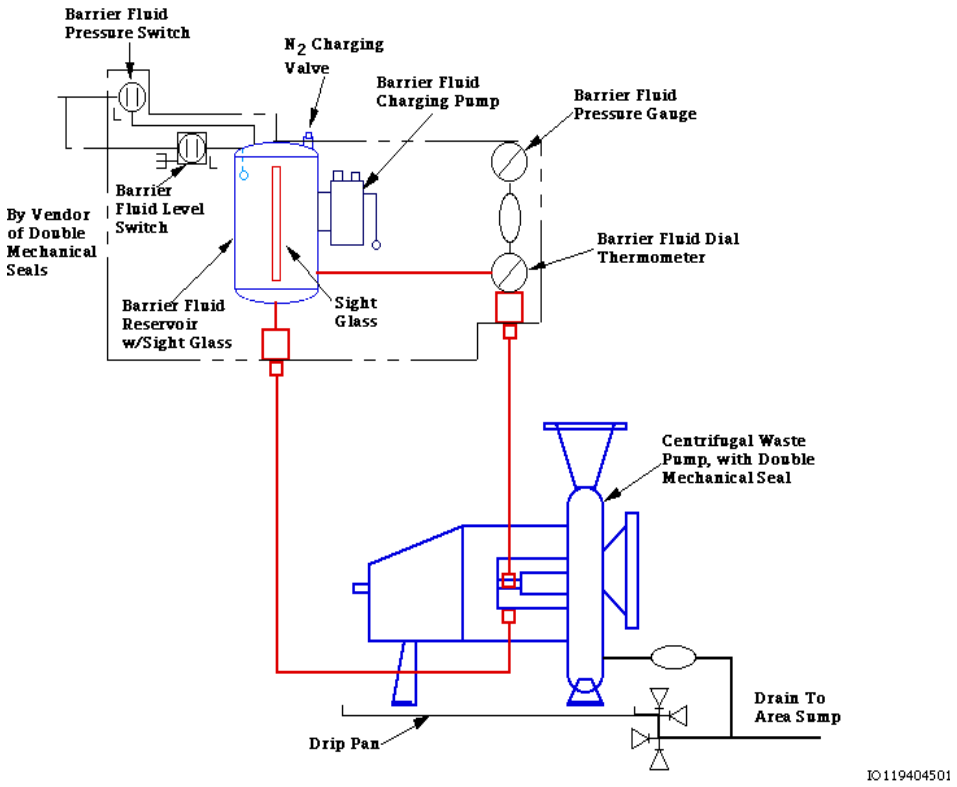


Figure 6 Pump Seal System

AQW Feed Pump

The function of the AQW Feed Pump is to control the feed rate of aqueous waste to the Rotary Kiln. The pump is a Milton Roy, High Performance Diaphragm (HPD), metallic, liquid end, metering pump. It is a constant speed, variable stroke, positive displacement, diaphragm pump rated for 114 gph at a discharge pressure of 134 psig. Flow to the RK AQW Nozzle is DCS controlled by adjustment of the pump stroke. A backpressure regulator valve is used to maintain a minimum backpressure of at least 5 psig above pump suction pressure. The setting is adjustable and it is currently set to 55psig. The backpressure is needed to assist in stabilizing the flow from the AQW Feed Pump. Maintaining a minimum 5 psig differential pressure across the AQW feed pump is necessary for proper pump operation. The HPD liquid end is particularly suitable for pumping hazardous liquids without leakage. The diaphragm is hydraulically balanced between the process liquid on one side and the hydraulic oil on the other side. The hydraulic oil takes the place of a mechanical connection between the pump plunger and diaphragm. The reciprocating motion provided by the motor is transferred to the diaphragm by the hydraulic oil. Figure 6, *Typical Diaphragm Pump Construction,* illustrates the construction of the diaphragm pump. Ball check valves are installed in the suction and discharge ports of the pump. These valves alternately open and close to allow flow to and from the pump. This construction eliminates any contact between the liquid being pumped and the source of energy. It also eliminates the possibility of leakage which is important when handling toxic liquids. The disadvantages are limited head and capacity. The AQW Feed Pump is located on the AQW Remote Skid. The power to the 1 hp motor driving the AQW Feed Pump is supplied from MCC 4.

Figure 7 Typical Diaphragm Pump Construction

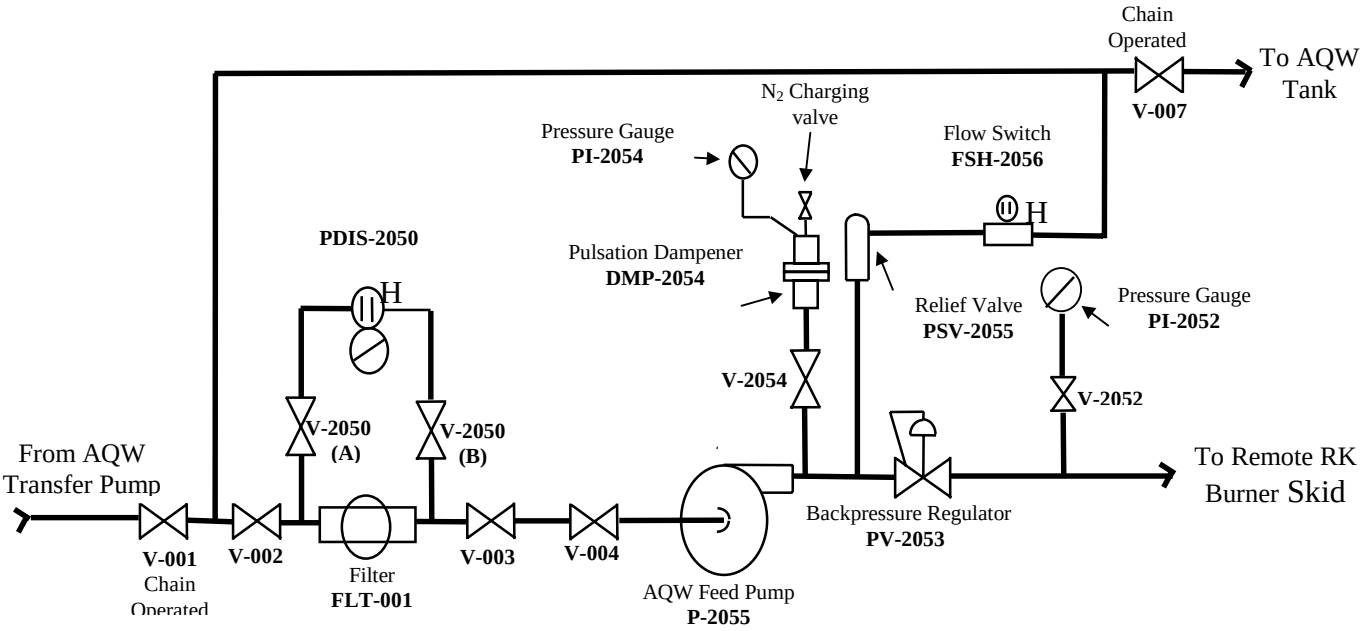
AQW Nozzle

The AQW Nozzle is a gun-type nozzle designed for injection of AQW into the RK. It is capable of passing particulate up to 1/16 inch in diameter and has a turndown ratio of 10:1. In this case, the maximum flow through the burner is 950 lb/hr with a minimum flow of 95 lb/hr. Atomizing steam is used to provide nozzle cooling and the atomization of the AQW. Atomizing steam to the nozzle is controlled by the Steam Flow Controller and is admitted to the AQW nozzle when the RK temperatures are > 1000°F. The Steam Flow Controller (H-261-MS-PIC-2008) operates Steam Pressure Control Valve H-261-MS-PCV-2008. The pressure control valve is automatically adjusted to maintain the setpoint entered into the DCS at point tag AW 2008PC-1.

AQW Remote Skid

The AQW Remote Skid is located near the Burner Management Control Panel outside the Ram Feed Area of the CIF. It contains the components illustrated on Figure 7, *AQW Remote Skid.*

The filter (H-261-AQW-FLT-001) on the suction of the AQW Feed Pump removes particulate from the waste and is monitored by a differential pressure switch H-261-AQW-PDIS-2050.



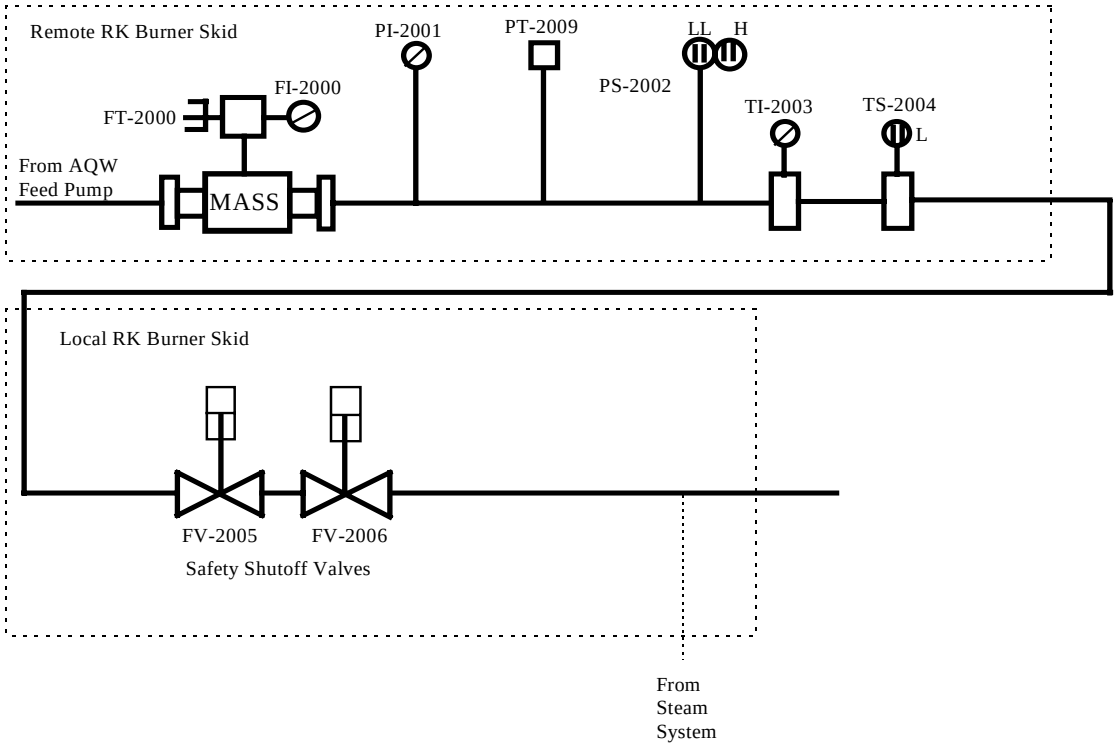
(Note All CLI numbers are preceded with H-262-AQW)

Figure 8 AQW Remote Skid

Local indication of filter differential pressure is provided to indicate the cleanliness of the filter. A DCS alarm (H-261-AQW-PDA-2050) will occur at 3 PSID to indicate flow restriction in the filter. The alarm is indicated at DCS point tag AW2055E-1. Actions necessary for the alarm can be found in 261-ARP-2050PA. A pulsation dampener is provided on the discharge of the AQW feed pump to minimize flow pulsation's caused by the action of the reciprocating diaphragm pump. The dampener has a nitrogen accumulator pressurized between 15 and 40 psig. The accumulator will absorb the pressure oscillations resulting in a stable output flow rate. A relief valve (H-261-AQW-PSV-2055) is connected to the discharge piping of the AQW feed pump. The relief will protect the piping and components from over-pressure by relieving pressure to the suction of the pump or the AQW tank when pressure reaches 120 psig. A high pressure condition can result from blockage of flow in the AQW feed line or failure of the backpressure regulating valve in the pump discharge. A flow switch (H-261-AQW-FSH-2056) is mounted in the discharge piping of the relief. The flow switch provides an alarm at the DCS (H-261-AQW-FAH-2056) at 2 gpm flow through the switch. This will inform the operator that the relief has lifted and an improper condition exists. This alarm is indicated on DCS point tag AW2055E-1. Actions for this alarm can b found on 261-ARP-AW2056FA. Backpressure regulator valve (H-261-AQW-PV-2053) is mounted on the remote AQW Skid in the discharge line of the AQW feed pump. The back pressure regulator will maintain pressure in the system at a minimum of 40 psig which aids in flow stabilization. Stable flow rates are necessary to allow accurate flow and pressure measurement, as well as proper incinerator nozzle operation.

RK Burner Skids

The remaining components in the flowpath between the remote AQW Skid and the RK are located on the RK Burner Local and Remote Skids. These components are depicted on Figure 8, *Remote and Local RK Burner Skids.*



*Note: All CLI numbers are preceded with **H-261-AQW-***

Figure 9 Remote and Local RK Burner Skids

The AQW mass flow transmitter (H-261-AQW-FT-2000) measures the flow from the AQW feed pump and provides a signal to the flow indicator controller H-261-AQW-2000 on the DCS. The flow controller compares the measured feed rate with the desired feed rate and sends a control signal to the AQW feed pump. This signal adjusts the stroke of the pump to control the feed rate. The flow transmitter also provides local and DCS indication of flow rate as well as an input to DCS flow switch H-261-AQW-FSH-2000. This switch will provide a High-flow alarm, H-261-AQW-FAH-2000, on the DCS at a flow rate of 950 lb/hr. This alarm is indicated at DCS point tag AW2000FC-1. Actuation of this alarm will automatically stop aqueous waste flow. Further actions for this alarm are listed in 261-ARP-AW2000FA.

Pressure transmitter H-261-AQW-PT-2009 supplies an input to DCS switch H-261-AQW-PSL-2009. The switch produces a low pressure alarm H-261-AQW-PAL-2009 at 0.5 psig.

This alarm is indicated at DCS point tag AW2009P-1. No automatic functions result from the alarm. Further actions for this alarm are listed in 261-ARP-AW2009PA.

Pressure switch H-261-AQW-PS-2002 provides a Low-Low H-261-AQW-PALL-2002 and a High pressure alarm H-261-AQW-PAH-2002 at 1 psig and 140 psig respectively. This alarm is indicated at DCS point tag AW2002PA-1. Actuation of the Low-Low alarm will automatically stop the AQW Feed Pump.

Further actions associated with the Low-Low pressure alarm are listed in 261-ARP-2002PA. There are no automatic functions associated with the High pressure alarm. Additional actions required with the High pressure alarm are listed in 261-ARP-2002PA-1.

Temperature switch H-261-AQW-TSL-2004 is installed in a thermowell. The switch actuates contacts to provide a Low AQW feed temperature alarm H-261-AQW-TAL-2004 on the DCS at 40°F. This alarm is indicated at DCS point tag AW2002PA-1. There are no automatic functions associated with this alarm. Additional actions required with the Low temperature alarm are listed on 261-ARP-AW2004TA.

Pneumatically Operated Valves

The DCS controlled supply valves associated with the AQW Tank are all pneumatically-operated. Table 1, *Aqueous Waste System Pneumatically operated Valves*, lists the pneumatic valves and Figure 2, *Aqueous Waste System Simplified Diagram* shows how the valves interface with the Aqueous Waste System.

Pneumatically operated valves are equipped with limit switches to provide position information to the DCS. All of the above-listed valves have position limit switches for both the OPEN and CLOSED position, with the exception of H-261-AQW-FV-2005 and 2006 having CLOSED indication only.

Pneumatically Operated Valve	System Interface
H-262-WTE-FV-0510	From Rad./Oils Solvent Pump
H-262-WTE-WD-FV-0511	From Building Sump Pump System
H-262-WTE-WD-FV-0522	From Regulated Sump Pump
WTE-WD-FV-0523	From Clean Sump Pump
H-262-WTE-FV-0528	From Spare Tank
H-262-WTE-FV-0530	To Spare Tank
H-261-AQW-FV-2005	To AQW Nozzle (Safety Shut-off Valve)
H-261-AQW-FV-2006	To AQW Nozzle (Safety Shut-off Valve)
H-262-WTE-FV-0309	To Blend Tank #1
H-262-WTE-FV-0406	To Blend Tank #2

Table 1 Aqueous Waste System Pneumatically Operated Valves

INSTRUMENTATION

3.06	**DESCRIBE the Aqueous Waste System instrumentation including, indicator location (local or Control Room) sensing points, instrument types, failure modes, and associated instrument controls.** **a. Level transmitter** **b. Specific gravity transmitter** **c. AQW Tank temperature** **d. Corrosion Transmitters** **e. AQW Tank Nitrogen Pressure** **f. AQW Pressure** **g. AQW Steam Pressure** **h. AQW Transfer Flow**

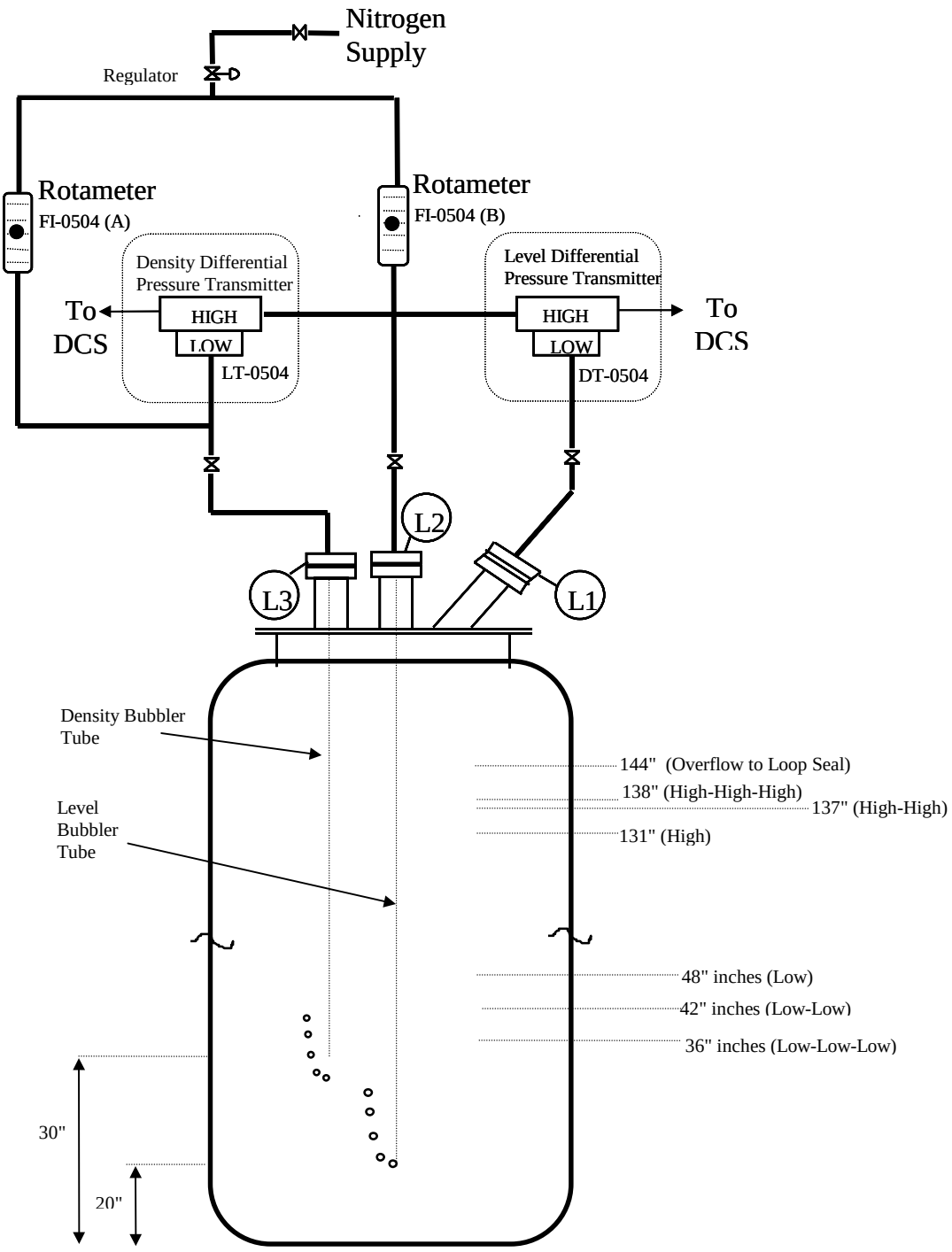
Level and Specific Gravity Transmitters (H-262-WTE-LT-0504, H-262-WTE-XT-0504)

AQW Tank level is measured by a bubbler tube arrangement using a nitrogen supply. Nitrogen is used in the tank farm tanks because of the hazardous conditions existing with tank farm fluids. The bubbler tube level detector works on the principle of hydrostatic pressure. The tube extends from the top of the tank downward to a point where the walls of the tank begin the curvature forming the bottom head of the tank. The amount of nitrogen pressure necessary to force bubbles from the tip of the bubbler tube is proportional to the height of the liquid. Meaning that higher levels require higher nitrogen pressure. The nitrogen regulator valve automatically increases or decreases pressure to maintain a constant flow to the tube. The vertical tube is kept empty by the nitrogen pressure forcing out bubbles. The tip of the tube is usually notched or cut at an angle to allow a steady stream of bubbles rather than periodic bursts of large bubbles. This feature stabilizes level indication. The system is initially set for sufficient nitrogen pressure to produce bubbles when level is at its maximum level. A decrease in tank level from this point would result in a lower hydrostatic pressure. More nitrogen flow would result and the regulator valve would reduce the nitrogen pressure to maintain a constant flow. Figure 9, *Tank Level Detection*, illustrates the arrangement of the bubbler tubes, differential pressure transmitters, and nitrogen supply. The differential pressure transmitters consist of a differential pressure detector and a transmitter. Differential pressure transmitter H-262-WTE-LT-0504 measures tank level, and differential transmitter H-262-WTE-XT-0504 measures specific gravity.

Tank Level Detection

The differential pressure detector senses the difference in pressure between the nitrogen pressure forcing the bubbles out of the tube (which is proportional to level), and the pressure on the top of the tank. Sensing the pressure on the top of the tank negates any effect of the nitrogen blanket on the level measurement. The blanket pressure increases the pressure associated with tank fluid level, and if not accounted for would result in indicated levels

higher



Note: All CLI numbers are preceded with ***H-262-WTE-***

Figure 10 Tank Level Detection

than actual and level indication would vary with nitrogen blanket pressure changes. The pressure associated with the level bubbler tube is fed to the HIGH pressure connection of the differential pressure transmitter and the blanket pressure is fed to the LOW pressure connection. As tank level changes the bubbler tube pressure changes affecting the measured differential pressure. This change in differential pressure causes the output signal from the transmitter to vary proportional to level.

Density Compensation

The output from the level transmitter must be compensated for the density of the fluid being measured. Measuring two fluids with different densities and the same height would produce different pressures sensed by the differential pressure transmitter. Even though the actual height of the fluids were the same the output indication would differ. Also, heating the tank contents would cause the contents to expand forcing the level to increase. The pressure sensed by the detector would be the same even though the height has changed so level indication would not change.

The function of the density transmitter is to compensate the output of the level transmitter in accordance with the following relationship.

$$Level = \frac{\mathrm{Pr}\,essure}{Density}$$

Where:

Level = the Actual Tank level

Pressure = the pressure sensed at the detector from the height of fluid in the tank

Density = the density of the fluid in the tank

Now, for example, if the temperature of the fluid in the tank increased a constant pressure would be measured due to the height of fluid. Heating the fluid caused its density to decrease resulting in the level indication increasing with the actual level. To further illustrate:

Assume a tank at 68°F has a level of 120 inches, which corresponds to 4.33 psig and a specific gravity of 1. The tank contents is now heated to 200°F, the heating of the tank causes the fluid to expand and the density decreases. The density of the fluid at 200°F is now 0.9539. What is the new level in the tank. Indicated level would not change since the pressure of the water would be the same. The pressure is the same because we did not add or remove any mass from the tank. Using the above equation however the new level can be determined as follows:

Level = pressure(4.33psig) / SG (.9539)

Level = 4.539 psig (This is the equivalent pressure to the new height at a SG. of 1.0)

ratioing:

Level/4.539 = 120 inches/4.33psig

Level = (120 inches/4.33psig) X (4.539)

Level = 125.8 inches (This is the new level in the tank due to expansion. Without the correction for the change in density the level indication would have been the same.)

The density signal is produced by measuring the difference in pressure between the level bubbler tube and the density bubbler tube. The tips of the tubes are at different heights in the tank. The density transmitter HIGH pressure connection is connected to the level bubbler tube and LOW pressure connection is connected to the shorter density bubbler tube. The difference in pressure sensed by the density transmitter will only be affected by changes in density of the fluid. The two signals are sent to the DCS which computes a compensated level measurement. The DCS calculates and displays actual tank level by dividing the uncompensated tank level input by the density input. The DCS also displays the specific gravity of the tank contents. Specific gravity is a ratio of density of the fluid measured to the density of water. A specific gravity measurement of > 1.0 means that the fluid is heavier (more dense) than water and a specific gravity > 1.0 means that the fluid is lighter (less dense) than water.

The DCS produces level indication, specific gravity indication, interlocks and alarms for the DCS. The level indicator can only indicate levels above the tip of the bubbler tube and specific gravity indication only for levels above the shorter bubbler tube. At the low-low level, the then current specific gravity input to the DCS is locked and is utilized by the DCS for density compensation until level reaches the reset of the low-low level switch. This is done to ensure level indication is available at low tank levels which can uncover the tip of the density bubbler. Level measurement cannot be made at levels below the tip of the level bubbler tube. Actual level indication is provided with a range of 0-150 INCHES on DCS point tag WTE0504L-2. Specific Gravity indication is provided with a range of 0.6-1.6 unitless at DCS point tag WTE0504L-2. DCS alarms are provided for the following tank levels:

- LOW-LOW-LOW AQW TK LVL (H-262-WTE-LALL-0504)
- LOW AQW TK LVL (H-262-WTE LAL-0504)
- HIGH AQW TK LVL (H-262-WTE-LAH-0504)
- HIGH-HIGH AQW TK LVL (H-262-WTE-LAHH-0504)
- HIGH-HIGH-HIGH AQW TK LVL (H-262-WTE-LAHH-0503)

Setpoints associated with these alarms are available from the setpoint document. The low-low-low level, high-high level, and high-high-high level also have interlocks associated with these instruments and will be discussed later.

AQW Tank Temperature (H-262-WTE-TT-0502)

AQW Tank temperature is measured with a Resistance Temperature Detector (RTD) sensor and transmitter. The RTD is mounted in a thermowell in the lower portion of the tank. The RTD does not come in contact with the fluid which protects it against the potentially corrosive environment. The temperature of the tank contents is conducted through the thermowell to the element. A spare RTD element is installed in the thermowell in case of failure of the one in use. The only action needed would be to disconnect the leads for the bad RTD and connect the leads for the spare RTD to the transmitter. The temperature transmitter converts the resistance change of the RTD with temperature to a current signal. The resistance of the RTD will increase with an increase in temperature and decrease with a decrease in temperature. A RTD failing by an open in its element will appear as a high resistance to the circuit and the resulting indication will be a high temperature of 110°F. A short in the RTD will be seen as a very low resistance and the will indicate a low temperature of 30°F. The current signal is fed to high and low temperature alarm switches and temperature indication on the DCS. DCS indication has a range of 30-110°F. Alarms are provided on the DCS for LOW (H-262-WTE-TAL-0502) temperature at 40°F and HIGH (H-262-WTE-TAH-0502) temperature at 100°F.

Corrosion Transmitters (H-262-WTE-AT-0505)

The AQW Tank is equipped with an electrical resistance probe, which is exposed to the potentially corrosive environment in the tanks. The probe is inserted in the side of the tank. The corrosion transmitter converts the probe corrosion (a function of increasing resistance) to a signal corresponding to a tank wall corrosion rate between 0 and 5 mils (a mil is .001 inches or one thousandth of an inch). The corrosion probe has an effective life of 5 mils. The DCS calculates the rate of corrosion and displays it within the range of 0-60 mils/year (mpy). A high corrosion alarm (H-262-WTE-AAH-0505) is provided on the DCS at 50 mpy/10 hours with the calculation performed every hour. Meaning that the calculation is performed hourly and averaged over a ten hour period to determine the corrosion rate extrapolated out to an annual rate.. Corrosion coupons are also used to measure corrosion. These samples of tank material are inserted in stacks into the tank. The coupons are placed in stilling wells and must be removed for inspection whenever a high corrosion alarm is received. These coupons are placed in positions where they will be submerged in the liquid waste so they are under the same conditions as the tank walls. The corrosion of the coupons can be related to actual tank corrosion conditions. A set of coupons will be pulled from the tank every two years and weighed to compare against weight loss due to corrosion for the period.

AQW Tank Nitrogen Pressure

Nitrogen is provided to the tank from the CIF Nitrogen System through regulator H-262-LN-PV-0506. The regulator is set to provide 2 inwc pressure to the tank. A nitrogen blanket is maintained to prevent the buildup of combustible gases in the void space above the tank contents. The AQW Tank nitrogen pressure is monitored to ensure proper tank operation and to ensure tank integrity. Local indication is provided by pressure gauge H-262-WTE-PI-0500. This pressure gauge is the only indication available for tank pressure.

The gauge is calibrated in INWC and has a range of -15 - 0 - +15 inwc. The nitrogen conservation vent operates to relieve nitrogen pressure if it reaches 8 inwc. The normal operating

range for the tank pressure is between 2 and 8 inwc.

The following DCS indications/alarms are associated with AQW Tank pressure:

- HIGH-HIGH pressure switch (H-262-WTE-PS-0518-B) provides DCS alarm (H-262-WTE-PATH-0518-B) at 1.5 psig (41.5 INWC). This alarm can only occur after the rupture disc bursts on high pressure. This alarm is indicated at DCS point tag WTE0518PA-1. Actuation of this alarm also provides automatic interlocks that will be discussed later.
- HIGH pressure switch (H-262-WTE-PSH-0500) provides DCS Alarm (H-262-WTE-PAH-0500) at 34.6 INWC. The AQW Tank nitrogen pressure is monitored to ensure proper tank operation. This alarm is indicated at DCS point tag WTE0518PA-1. There are no automatic functions associated with this alarm.
- LOW pressure switch (H-262-WTE PSL-0500) provides a DCS Alarm (H-262-WTE-PAL-0500) at 0 INWC psig. This alarm is indicated at DCS point tag WTE0518PA-1. Actuation of this alarm also provides automatic interlocks that will be discussed later.

AQW Pressures

Gauges

System pressures are monitored at various locations within the system. Transfer pump discharge pressure is indicated on local pressure gauge H-262-WTE-PI-0513. The diaphragm seal gauge has a range of 0-100 psig. This pressure indication is used to evaluate the operation of the transfer pump.

AQW feed pump discharge pressure is indicated on the RK remote AQW skid by pressure gauge H-261-AQW-PI-2052. The diaphragm seal gauge has a range of 0-160 psig. This pressure indication is used to evaluate the operation of the AQW feed pump.

AQW feed pressure is also indicated on the Remote RK Burner Skid by pressure gauge H-261-AQW-PI-2001. The diaphragm seal gauge has a range of 0-160 psig. This pressure indication is used to evaluate the system operation downstream of the mass flow transmitter.

AQW feed pressure is also displayed on H-261-AQW-PI-2017 located at the AQW nozzle. The diaphragm seal pressure gauge has a range of 0-160 psig.

Transmitter

The pressure from the AQW feed pump to the Incinerator Nozzle is measured by pressure transmitter H-261-AQW-PT-2009. This transmitter is located on the Remote RK Burner Skid. The transmitter produces an electrical signal proportional to AQW pressure. The signal is used by the DCS to provide indication with a range of 0-200 psig, and operates DCS switch H-261-AQW-PSL-2009. This switch actuates a Low RK AQW Pressure alarm, (H-261-AQW-PAL-2009), at 0.5 psig. This alarm is indicated at DCS point tag AW2009PA.

Pressure Switches

Pressure switch H-261-AQW-PS-2002 provides a low-low AQW pressure alarm H-261-AQW-PALL-2002, at 1 psig and a high AQW pressure alarm H-261-AQW-PAH-2002 at 114 psig. The pressure switches are located on the Remote RK Burner Skid. These alarms are at DCS point tags AW2002PA and AW2002PA-1.

AQW Steam Pressure

The steam pressure to the AQW Burner is measured by pressure transmitter H-261-MS-PT-2008. The transmitter is located on the remote RK Burner Skid. It provides input for DCS indication of steam pressure to the AQW nozzle with a range of 0-200 psig. The signal is also compared to the setpoint of the DCS steam pressure controller to provide a control signal to the steam pressure control valve. Steam pressure and setpoint is indicated at DCS point tag AW2008PC-1. The pressure transmitter also provides input to DCS switch H-261-MS-PSL-2008 for a RK AW Steam Pressure Low alarm (H-261-AQW-PAL-2009) at 90 psig. This alarm is also indicated at DCS point Tag AW2008PC-1. Normal pressure indication is 120 psig.

AQW Transfer Flow

AQW transfer flow to the Blend Tanks or the Spare Tank is measured by a coriolis, mass-type flow meter H-262-WTE-FT-0517. Installed on the discharge of the pump, the flow sensor measures the amount of twist produced from flow through a U-shaped sensing tube. Figure 10, *Operating Principle of Coriolis Mass Flowmeter*, depicts this flow induced twisting force. The higher the mass flow rate the larger the twisting force. The amount of twist is measured by magnetic position detectors which provide an input signal to the flow transmitter. The measured flow signal is essentially unaffected by variations in fluid properties, such as viscosity, pressure, temperature, pulsation's, entrained gases, and suspended solids.

Figure 11 Operating Principle of Coriolis Mass Flowmeter

The DCS takes the input signal from the flow transmitter and performs the following functions:

- Local and remote indication of transfer flow with a range of 0 to 500 lb/min
- Displays total flow in lbs on the DCS
- Operates DCS switch when total flow reaches setpoint entered by the operator to stop the pump automatically

AQW Feed Flow

AQW feed flow to the RK Nozzle is measured by coriolis mass flow meter H-261-AQW-FT-2000. The transmitter is located on the remote RK Burner Skid. It produces a signal proportional to feed flow for the following functions:

- Provides input to the feed controller H-261-AQW-FC-2000
- Provides local and DCS indication of flow rate with a range of 1-1000 lb/hr
- Provides an input to DCS switch H-261-AQW-FSH-2000. The flow switch will operate when flow rate reaches the setpoint of 950 lb/hr to stop the Aqueous Waste flow.
- Provides an input to the DCS flow recorder (H-261-ROW-FR-2300)

The feed controller has a setpoint entered by the operator which determines feed rate. The feed controller senses actual feed rate and adjusts the feed pump stroke accordingly to match the rate required by the controller.

Other DCS indications include the following:

- AQW Transfer Pump Run Status
- AQW Transfer Pump Field Start
- AQW Tank Agitator Status
- AQW Tank Agitator Field Start
- AQW Tank to Spare Tank valve position indication
- AQW Tank to Blend Tank #1 valve position indication
- AQW Tank to Blend Tank #2 valve position indication

CONTROLS, INTERLOCKS AND ALARMS

3.05	**INTERPRET the following Aqueous Waste System alarms, to include the conditions causing alarm actuation and the basis for the alarm:** **a. Level alarms** **b. Temperature alarms** **c. Tank pressure alarms** **d. Differential pressure alarms** **e. Corrosion alarms** **f. Flow alarms** **g. System pressure alarms**
3.07	**EXPLAIN how the following Aqueous Waste System equipment is controlled to include control locations (local or control room), basic operating principles of control devices, and the effects of each control on the component operation:** **a. AQW Transfer Pump** **b. AQW Feed Pump** **c. AQW Transfer Switch** **d. AQW Tank Agitator** **e. AQW Feed Controller** **f. AQW Transfer Controller**

Controls

AQW Transfer Pump

The AQW Transfer Pump is normally controlled by the DCS from point tag WTE0516E-1. It may also be started and stopped locally using the local MOA station, and local start/stop push-button. The MOA station is a three (3) position maintained switch. The operation of each position is discussed below.

MANUAL position: When the field MOA is placed in the MANUAL position, the pump may be started by the field MOA START push-button. The pump can NOT be started or stopped by DCS controls. The only permissives required to start the pump are hardwired. The AQW transfer pump has two (2) hardwired interlocks. The pump seal tank must be above the low level point and the pump seal pressure must be above the low pressure setpoint. No permissives from the DCS are required to start the pump. No permissives are generated to complete a logic flowpath in the DCS/PLC to perform an automatic or DCS started function when the pump is running.

OFF position: When the field MOA switch is placed in the OFF position the pump stops. The pump can NOT be started by the field MOA START push-button. The pump can NOT be started by DCS controls.

AUTO position: When the field MOA switch is placed in the AUTO position the pump may be started by field MOA START push-button when the DCS/PLC permissives are present. The pump may be started from the DCS/PLC if it is permissible and the required DCS/PLC permissives are present. Pump running generates a permissive signal for DCS/PLC if required.

AQW Tank Agitators

The AQW Tank Agitator is normally controlled by the DCS from point tag WTE0501E-1. It may also be started and stopped locally using the local MOA station, and local start/stop push-button. The MOA station is a three (3) position maintained switch. The operation of each position is similar to the AQW transfer pump MOA station.

RK AQW Flow

The AQW Feed Pump is normally controlled by the DCS from point tag AW2055E-1. The motor can also be started and stopped locally. AQW Flow Controller H-261-AQW-FC-2000 controls the stroke of the feed (metering) pump. The controller will automatically adjust the feed flow rate in response to setpoint entries made at DCS point tag AW2000FC-1 by the Control Room Operator. The RK AQW Feed Start/Stop switch is controlled from DCS point tag AW2016E-1.

AQW Transfer Switch

The AQW Transfer Switch is used to select the destination for the discharge of the AQW Transfer Pump. The DCS switch can be found at point tags WTE0519HS-1 and WTE0519HS-2. The contents of the AQW Tank may be pumped to: (1) the AQW Feed Pump, (2) the Spare Tank, (3) Blend Tank #1, or (4) Blend Tank #2. The fifth position on the switch is SAMPLE which is used to recirculate the contents of the tank using the AQW Transfer Pump. When the switch is operated to a tank position and the permissives are met the associated transfer valve will open once the pump is running.

AQW Transfer Controller

The desired AQW transfer flow, in lbs, is entered into the DCS at DCS point tag WTE0517F-1. This controller is used whenever transfers are being made to either of the two Blend Tanks or to the Spare Tank. The transfer flow rate in lb/min is indicated on the DCS and locally. The controller also totalizes the transfer flow and displays the total in lbs at DCS point tag WTE0517F-1. When total flow reaches the desired flow the controller will stop the pump using DCS high flow switch H-262-WTE- FSH-0517. The quantity setpoint is also automatically zeroed when the position of the transfer switch is changed.

AQW Steam Pressure Controller

The DCS AQW Steam Pressure Controller H-261-MS-PIC-2008, RK AQW STEAM PRESS CTRL, is used to set the desired steam pressure to the Incinerator Nozzle. Typically, this controller is set at 120 psig. The pressure of the steam is sensed by pressure transmitter H-261-MS-PT-2008. The pressure signal is fed to the steam pressure controller which adjusts the position of flow control valve H-261-MS-PCV-2008. This will raise and lower steam pressure in response to the setting of the steam pressure controller compared to actual steam pressure.

3.08	**DESCRIBE the interlocks associated with the following Aqueous Waste System equipment to include the interlock actuating conditions, effects of interlock actuation, and the reason the interlock is necessary:** **a. AQW Tank Agitator** **b. AQW Feed Pump** **c. AQW Transfer Pump** **d. AQW system interface valves**

Interlocks

The interlocks associated with AQW System are designed to prevent damage to system components or prevent inadvertently mixing wastes before samples can be taken to determine compatibility. The permissives associated with tank waste transfer operations are designed to prevent:

- Simultaneous transfer to and from the same tank
- Simultaneous transfer to the same tank from two different sources
- Transfer to a tank with abnormal nitrogen blanket conditions
- Transfer to a tank with abnormal level conditions
- Transfer to a tank or waste feed with combustible gas detected

The DCS is relied upon to determine whether or not the permissive are met to meet the objectives listed above. Operating with the MOA switch in the AUTO position will ensure these conditions are met prior to operation. The MANUAL position will defeat these important interlocks and should not be done unless specifically approved.

AQW Tank Agitator

The logic associated with the AQW Tank Agitator is depicted on CIF Tank Farm Logic Diagram Sheet 4 Instruments, SE5-2-2006178. The Aqueous Tank Agitator may remain running continuously. Starting of the motor is from the DCS or locally. The following conditions must exist to start the agitator from the DCS or locally in automatic.

Preparation:

- Aqueous Waste Tank Agitator field MOA switch in the AUTO position.

Permissives:

- AQW tank N_2 pressure not low
- AQW tank N_2 pressure not high-high
- AQW tank level not low-low-low
- DCS or local start push-button depressed

Normal nitrogen pressure must be available to blanket the tank contents prior to agitating. The level in the tank is interlocked to agitator operation to ensure the lower blade is covered with fluid. The lower blade contains the stabilizer that equalizes forces on the agitator assembly.

AQW Transfer Pump to AQW Feed Pump

The logic associated with starting the AQW Transfer Pump and aligning the system to the AQW Feed Pump is depicted on CIF Tank Farm Logic Diagram Sheet 17 Instruments, SE5-2-2006263. The following conditions must exist to start the AQW Transfer Pump to supply AQW flow to the AQW Feed Pump:

Preparation:

- Aqueous Waste Transfer Pump field MOA switch in the AUTO position
- DCS Aqueous Waste Transfer Switch (WTE0519HS-1) selected to AQW Feed Pump position

Permissives:

- AQW tank N_2 pressure not low.
- AQW tank N_2 pressure not high-high
- AQW tank level not low-low-low
- Supply valve to AQW Tank from Rad Oils System must be closed
- Supply valve to AQW Tank from Building Sump System must be closed
- Supply valve to AQW Tank from Regulated Sump Pump must be closed
- Supply valve to AQW Tank from Clean Sump Pump must be closed
- Supply valve to AQW Tank from Spare Tank must be closed
- AQW Transfer Pump Discharge to Blend Tank #1 valve must be closed
- AQW Transfer Pump Discharge to Blend Tank #2 valve must be closed
- AQW Transfer Pump Discharge to Spare Tank must be closed
- AQW Transfer Pump, Pump Seal pressure must not be low
- AQW Transfer Pump, Pump Seal liquid level must not be low
- No combustible gases detected in the Tank Farm, Tank Farm Stack, or Incinerator Areas

The permissives ensure that the nitrogen blanket is operating normally. Sufficient volume exists for operation of the pump (above low-low-low level). No other flow into the tank is allowed while pumping to AQW feed and flow will only go to the AQW feed pump. Pump seal system parameters must be normal for pump operation and no combustible gas can be detected. Once the transfer is started the valves involved in the permissives are inhibited until the transfer is complete. This ensures that the characteristics of the AQW flow to the Rotary Kiln is always known, and to maintain accountability of AQW volumes. Additionally uncontrolled flow from the AQW tank to another tank without sampling for compatibility may produce an exothermic reaction. If these conditions change the pump will automatically shut off.

AQW Transfer Pump on Recirculation

The logic associated with starting the AQW Transfer Pump and aligning the system for recirculation is depicted on CIF Tank Farm Logic Diagram Sheet 17 Instruments, SE5-2-2006263. The DCS (WTE0516E-1) or local Start push-button must be operated after meeting the conditions below. The following conditions must exist to start the AQW Transfer Pump for recirculation purposes:

Preparation:

- SAMPLE selected using the AQW Transfer Switch at point tag WTE0519HS-1 or 2 on the DCS
- Aqueous Waste Transfer Pump field MOA switch must be in the AUTO position

Permissives:

- AQW tank N_2 pressure not low
- AQW tank N_2 pressure not high-high
- AQW tank level not low-low-low
- Supply valve to AQW Tank from Rad Oils System closed
- Supply valve to AQW Tank from Building Sump System closed
- Supply valve to AQW Tank from Regulated Sump Pump closed
- Supply valve to AQW Tank from Clean Sump Pump closed
- Supply valve to AQW Tank from Spare Tank closed
- AQW Transfer Pump, Pump Seal Nitrogen Pressure must not be low
- AQW Transfer Pump, Pump Seal liquid level must not be low
- No combustible gases detected in the Tank Farm, Tank Farm Stack, or Incinerator Areas

The permissives ensure that the nitrogen blanket is operating normally. Sufficient volume exists for operation of the pump (above low-low-low level). No other flow into the tank is allowed while recirculating the tank contents. Pump seal system parameters must be normal for pump operation and no combustible gas can be detected. Once the recirculation is started the valves involved in the permissives are inhibited until the recirculation is complete.

AQW Transfer to Spare Tank

The logic associated with starting the AQW Transfer Pump and aligning the system for transfer to the Spare Tank is depicted on CIF Tank Farm Logic Diagram, Sheet 22 Instruments, W2017835. The DCS or local Start push-button must be operated after meeting the conditions below. The following conditions must exist to start the AQW Transfer Pump for transfer to the Spare Tank. The Aqueous Waste Transfer pump discharge valve to the Spare Tank opens after a one minute time delay.

Preparation:

- Spare Tank selected using AQW Transfer Switch at point tag WTE0519HS-1
- Aqueous Waste Transfer Pump field MOA switch must be in the AUTO position
- DCS Flow Controller set for the quantity of Aqueous Waste desired for transfer (not at 0) from DCS point tag WTE0517F-1

Permissives:

- AQW tank N_2 pressure not low
- AQW tank N_2 pressure not high-high
- AQW tank level not low-low-low
- Supply valve to AQW Tank from Rad Oils/Solvent System closed
- Supply valve to AQW Tank from Building Sump System closed
- Supply valve to AQW Tank from Regulated Sump Pump closed
- Supply valve to AQW Tank from Clean Sump Pump closed
- Supply valve to AQW Tank from Spare Tank closed
- AQW Transfer Pump Discharge to Blend Tank #1 valve closed
- AQW Transfer Pump Discharge to Blend Tank #2 valve closed
- AQW Transfer Pump, Pump Seal Nitrogen Pressure not low
- AQW Transfer Pump, Pump Seal liquid level not low
- Spare Tank N_2 pressure not low
- Spare Tank N_2 pressure not high-high
- Spare Tank Level not high-high
- Spare Tank Level not high-high-high
- Supply valve to Spare Tank from Rad Oils/Solvent System closed
- Blend Tank #2 valve to Spare Tank closed
- Blend Tank #1 valve to Spare Tank closed
- Supply valve to Spare Tank from Regulated Sump Pump closed.
- Spare Tank to Blend Tank #1 valve closed
- Spare Tank to Blend Tank #2 valve closed

- No combustible gases detected in the Tank Farm, Tank Farm Stack, or Incinerator Areas

The permissives ensure that the nitrogen blanket is operating normally. Sufficient volume exists for operation of the pump (above low-low-low level). No other flow into the AQW tank is allowed while pumping to the Spare Tank. The AQW pump is the only flow into the Spare Tank. AQW pump Seal System parameters must be normal for pump operation and no combustible gas can be detected. Spare Tank level must be below the High-High level to prevent overflow of the tank. Once the transfer is started the valves involved in the permissives are inhibited until the transfer is complete. Additionally uncontrolled flow form the AQW tank to another tank without sampling for compatibility may produce an exothermic reaction. If these conditions change the pump will automatically shut off.

AQW Transfer to Blend Tank #1

The logic associated with starting the AQW Transfer Pump and aligning the system for transfer to Blend Tank #1 is depicted on CIF Tank Farm Logic Diagram Sheet 23 Instruments, W2017836. The DCS or local Start push-button must be operated after meeting the conditions below. The following conditions must exist to start the AQW Transfer Pump for transfer to Blend Tank #1. The Aqueous Waste Transfer pump discharge valve to Blend Tank #1 opens after a one minute time delay.

Preparation:

- Blend Tank #1 selected using AQW Transfer Switch at DCS point tag WTE0519HS-2
- DCS Flow Controller set for the quantity of Aqueous Waste desired for transfer (not at 0) from DCS point tag WTE0517F-1
- Aqueous Waste Transfer Pump field MOA switch must be in the AUTO position

Permissives:

- AQW tank N_2 pressure not low
- AQW tank N_2 pressure not high-high
- AQW tank level not low-low-low
- Supply valve to AQW Tank from Rad Oils System closed
- Supply valve to AQW Tank from Building Sump System closed
- Supply valve to AQW Tank from Regulated Sump Pump closed
- Supply valve to AQW Tank from Clean Sump Pump closed
- Supply valve to AQW Tank from Spare Tank closed
- AQW Transfer Pump Discharge to Blend Tank #1 valve closed
- AQW Transfer Pump Discharge to Blend Tank #2 valve closed
- AQW Transfer Pump Discharge to Spare Tank valve closed
- AQW Transfer Pump, Pump Seal Nitrogen Pressure not low
- AQW Transfer Pump, Pump Seal liquid level not low

- Blend Tank #1 N_2 pressure not low
- Blend Tank #1 N_2 pressure not high-high
- Blend Tank #1 Level not high-high
- Blend Tank #1 Level not high-high-high
- Supply valve to Blend Tank #1 from Rad Oils System must be closed
- Supply valve to Blend Tank #1 from Spare Tank must be closed
- Fuel Oil Transfer Pump Discharge to Blend Tank #1 valve closed
- Blend Tank #1 valve to Blend Feed Pump closed
- Blend Tank #1 valve from Blend Feed Pump closed
- No combustible gases detected in the Tank Farm, Tank Farm Stack, or Incinerator Areas

The permissives ensure that the nitrogen blanket is operating normally. Sufficient volume exists for operation of the pump (above low-low-low level). Blend Tank level must be below the High-High level to prevent overflow of the tank. No other flow into the AQW tank is allowed while pumping to the Blend Tank. The AQW pump is the only flow into the Blend Tank. AQW pump Seal System parameters must be normal for pump operation and no combustible gas can be detected. Once the transfer is started the valves involved in the permissives are inhibited until the transfer is complete. Additionally uncontrolled flow form the AQW tank to another tank without sampling for compatibility may produce an exothermic reaction. If these conditions change the pump will automatically shut off.

AQW Transfer to Blend Tank #2

The logic associated with starting the AQW Transfer Pump and aligning the system for transfer to Blend Tank #2 is depicted on CIF Tank Farm Logic Diagram Sheet 24 Instruments, W2017837. The DCS or local Start push-button must be operated after meeting the conditions below. The following conditions must exist to start the AQW Transfer Pump for transfer to Blend Tank #1. The Aqueous Waste Transfer pump discharge valve to Blend Tank #1 opens after a one minute time delay.

Preparation:

- Blend Tank #2 selected using AQW Transfer Switch at DCS point tag WTE0519HS-2
- DCS Flow Controller set for the quantity of Aqueous Waste desired for transfer (not at 0) from DCS point tag WTE0517F-1
- Aqueous Waste Transfer Pump field MOA switch must be in the AUTO position

Permissives:

- AQW tank N_2 pressure not low
- AQW tank N_2 pressure not high-high
- AQW tank level not be low-low-low
- Supply valve to AQW Tank from Rad Oils System closed

- Supply valve to AQW Tank from Building Sump System closed
- Supply valve to AQW Tank from Regulated Sump Pump closed
- Supply valve to AQW Tank from Clean Sump Pump closed
- Supply valve to AQW Tank from Spare Tank closed
- AQW Transfer Pump Discharge to Blend Tank #1 valve closed
- AQW Transfer Pump Discharge to Blend Tank #2 valve closed
- AQW Transfer Pump Discharge to Spare Tank valve closed
- AQW Transfer Pump, Pump Seal Nitrogen Pressure not low
- AQW Transfer Pump, Pump Seal liquid level not low
- Blend Tank #2 N_2 pressure not low
- Blend Tank #2 N_2 pressure not high-high
- Blend Tank #2 Level not high-high
- Blend Tank #2 Level not high-high-high
- Supply valve to Blend Tank #2 from Rad Oils Solvents System must be closed
- Rad. Organic Transfer Pump Discharge to Blend Tank #2 from to must be closed
- Fuel Oil Transfer Pump Discharge to Blend Tank #2 valve closed
- Blend Tank #1 valve to Blend Feed Pump closed
- Blend Tank #1 valve from Blend Feed Pump closed
- No combustible gases detected in the Tank Farm, Tank Farm Stack, or Incinerator Areas

The permissives ensure that the nitrogen blanket is operating normally. Sufficient volume exists for operation of the pump (above low-low-low level). No other flow into the AQW tank is allowed while pumping to the Blend Tank. The AQW pump is the only flow into the Blend Tank. AQW pump Seal System parameters must be normal for pump operation and no combustible gas can be detected. Once the transfer is started the valves involved in the permissives are inhibited until the transfer is complete. Additionally uncontrolled flow form the AQW tank to another tank without sampling for compatibility may produce an exothermic reaction. If these conditions change the pump will automatically shut off.

Alarms

Limitations associated with the AQW System or AQW operations in the CIF are as follows:

- Maximum flow rate from AQW Tank to the RK is 950 lb/hr
- Minimum Steam Pressure to the AQW Nozzle is 110 psig
- Tanks will be filled to only 90% of capacity
- Laboratory compatibility tests will be performed prior to every addition to a tank/container unless the tank/container contains the same material as the waste being added; process knowledge demonstrates the waste being added is compatible with the waste in the tank; or the tank is empty.

- Each batch of liquid or waste blend accumulated in one of the CIF waste storage tanks will be analyzed before the waste is fedpumped to the incinerator.
- The SOP requires that the AQW tank be recirculated and agitated prior to sampling.
- Cooling steam is cut in to the AQW nozzle above 1000 °F RK temperature to maintain nozzle temperature within design limits.

AQW Associated Alarms and Setpoints

Table 2 lists the alarms that are associated with the AQW System

ALARM	SETPOINT	DEVICE	DCS POINT TAG
AQW Tank Level Low-Low-Low	36 inches *	H-262-WTE-LSLL-0504	WTE0504L-1
AQW Tank Level Low-Low	42 inches	H-262-WTE-LSLL-0504(A)	NONE
AQW Tank Level Low	48 inches	H-262-WTE-LSL-0504	WTE0504L-1
AQW Tank Level High	131 inches	H-262-WTE-LSH-0504	WTE0504L-2
AQW Tank Level High- High	137 inches	H-262-WTE-LSHH-0504	WTE0504L-21
AQW Tank Level High-High-High	138 inches	H-262-WTE-LSHH-0503	WTE0504L-21
RK AW Temperature Low	40 °F	H-261-AQW-TSL-2004	AW2002PA-1
AQW Tank N_2 Pressure Low	0 inwc	H-262-WTE-PSL-0500	WTE0518PA-1
AQW Tank N_2 Pressure High	34.6 inwc	H-262-WTE-PSH-0500	WTE0518PA-1
AQW Tank N_2 Pressure High-High	1.5 psig	H-262-WTE-PS-0518-(B)	WTE0518PA-1
AQW Tank Temperature Low	40 °F	H-262-WTE-TSL-0502	WTE0502T-1
AQW Tank Temperature High	100 °F	H-262-WTE-TSH-0502	WTE0502T-1
RK AW Mass Flow Rate High	950 lb/hr	H-261-AQW-FSH-2000	AW2000FC-1
RK AW Waste Pressure Low	0.5 psig	H-261-AQW-PSL-2009	AW2009P-1
RK AW Waste Pressure Low-Low	1 psig	H-261-AQW-PS-2002	AW2005HV-1
RK AW Waste Pressure High	140 psig	H-261-AQW-PS-2002	AW2002PA-1
RK AW Steam Pressure Low	90 psig	H-261-MS-PSL-2008	AW2008PC-1
RK AW Steam Pressure Low-Low	80 psig	H-261-MS-PSLL-2011	AW2008HV-1
RK AW Steam Pressure High	150 psig	H-261-MS-PSLL-2011	AW2011PA-1
RK AW Steam Pressure Low	80 psig	H-261-MS-PS-2012	AW2012PA-1
RK AW Steam Pressure High	150 psig	H-261-MS-PS-2012	AW2012PA-1
RK AW Pump Bypass Flow High	2 gpm	H-261-AQW-FSH-2056	AW2055E-1
AQW Tank Corrosion High	50mpy/10h	H-262-WTE-ASH-0505	WTE0505X-1
RK AQW Diff. Pressure High	3 psid	H-261-AQW-PDIS-2050	AW2055E-1
RK AQW Steam Flow Low	40 lb/hr	H-261-MS-FSL-2013	AW2013F-1
RK AQW Gun Out of Position	Actuate	H-261-INC-ZS-2019	AW2019WA-1
RK AQW Temperature Low	40°F	H-261-AQW-TSL-2004	AW2002PA-1

***** *This setpoint is in the process of being changed to 20 inches*

Table 2 AQW Alarms and Setpoints

SYSTEM INTERRELATIONS

3.09	**DESCRIBE the operational interrelationships between the Aqueous Waste System and the following support systems, to include the effects of a failure of the supporting system and the effects of an improper alignment between the systems:** **a. DCS** **b. Heat Trace System** **c. Electrical Distribution System** **d. Instrument Air System** **e. Nitrogen System** **f. Waste Vent System**

DCS

As with most systems associated with the CIF, control of the AQW System is accomplished through the DCS. Pump operation and selection of destination to be pumped to or received from are accomplished using the DCS. AQW tank operating parameters such as temperature, pressure, and level are all monitored by the DCS. The normal operation of the Aqueous waste system depends on the proper operation of the DCS system. The DCS is relied upon to control and indicate parameters associated with the AQW system. A loss of the DCS system will prevent the normal operation of the AQW System.

Heat Trace System

The Heat Trace System provides freeze protection for AQW associated piping and valves. A sustained loss of the Heat Trace system may cause system temperatures to drop to the low temperature alarm setpoint. These low temperature alarms are designed to warn the operator of unacceptable viscosity conditions in the fluid. This may lead to a normal shutdown of the Incinerator if the viscosity affects pumping and flow parameters.

Electrical Distribution System

The Electrical Distribution System provides electrical power for the operation of the AQW Tank Transfer Pump, AQW Feed Pump, Heat Trace, and AQW Tank Agitator. The loss of this support system will prevent the operation of the system components. Electrical Distribution system operation is critical to the operation of the AQW System.

Instrument Air System

The Instrument Air System provides the motive force to operate AQW System air-operated valves. A loss of or reduced instrument air pressure can prevent the opening of system flow isolation valves. All valves associated with the AQW system fail shut on loss of instrument air.

Nitrogen System

The Nitrogen System supplies a blanket on the AQW tank to prevent the buildup of explosive vapors in the free space above the liquid in the tank. In addition, the Nitrogen System supplies purge for the bubbler system used in waste tank level measurement and Pump Seal System reservoir pressure. A high or low nitrogen pressure in the tank will shut down the operation of the tank through automatic interlocks. A loss of bubbler pressure will result in a tank low-low-low level alarm which shuts off the agitator and the transfer pump. Actions should be taken to terminate flow into the tank without tank level indication. A loss of pump seal nitrogen pressure will cause the pump to shut off preventing leakage from the seals during operation.

Waste Vent System

The AQW Tank is vented to the Waste Vent System. This system directs any gases vented from the AQW tank through HEPA filters and a carbon canister prior to elevated release via the Tank Farm Stack. Proper operation of the waste vent system is critical to the safe operation of the AQW tank. Isolation of any part of the tank vent which prevents flow from the conservation vent can lead to overpressurizing the tank. Caution should be exercised when operating the Tank Vent System equipment.

INTEGRATED PLANT OPERATIONS

4.01	**Identify the key performance indicators used to predict or verify normal operation of the Aqueous Waste System.**
4.02	**DETERMINE the effects on the Aqueous Waste System and the integrated plant response when given any of the following:** **a. Indications/alarms** **b. Malfunctions/failure of components** **c. Operator actions**
4.03	**Given the applicable procedures and plant conditions, DETERMINE the actions necessary to perform the following Aqueous Waste System operations:** **a. Aqueous Waste Tank recirculation and sampling** **b. Establishing Aqueous Waste Tank recirculation to the Aqueous Waste Feed Pump** **c. Aqueous Waste Transfer to Blend Tank #1 or #2** **d. Aqueous Waste Transfer to the Spare Tank**

Normal Operations

Operations associated with the Aqueous Waste System are controlled per SOP-AQW-01 R, *Aqueous Waste Operations (U).*

With the exception of the Rad Oils/Solvents Unloading Pump, the waste tank transfer pumps may be started by the operator using the DCS. The Rad Oils Solvent Unloading Pump is started locally after it has been connected to a source. The valves (pneumatically operated) in the supply lines from other sources are kept closed by the DCS during the transfer process. If the level in the AQW Tank reaches the HIGH-HIGH point (137"), the DCS will stop the pump and close the associated valves. The desired amount of transfer is entered into the flow transfer controller and will stop the pump after the desired transfer.

Sampling AQW Tank

The AQW Tank shall be recirculated prior to sampling to ensure a representative sample is obtained. The amount of recirculation time will be determined from calculations performed per Section 4.2 of 261-SOP-AQW-01R Aqueous Waste Operations, an example is given below. The recirculation flow rate is 60gpm or 3600 gph. The tank has approximately 49 gallons per inch. Multiplying the level in the tank by 49 will give the total gallons in the tank. Dividing the total gallons by 3600 gph will solve for the number of hours needed to recirculate the tank.

Example: The AQW tank has a level of 90 *inches.* How many hours of recirculation is necessary to recirculate the tank contents?

$$\text{\# Hours Recirculate} = \frac{49 gal}{inwc} \frac{1 hr}{3600 gal} 90 \; inches$$

\# Hours Recirculate = 1.225 hrs

Tank sampling is necessary to determine the heating value and density of the contents. Heating values exceeding 5000 Btu per pound or specific gravity greater than 1.05 requires that the tank contents be diluted with process water to reduce these values. The Chemistry Coordinator will determine the required dilution amount. The expected amount of level increase will be determined from calculations performed per Section 4.2 of 261-SOP-AQW-01R. Since a flow meter is not available to measure the added process water, tank level indication is used to measure the amount of water added. The amount of water provided by the Chemistry Coordinator is giving in units of inches, This value is added to the current AQW tank level to determine expected level. The amount of service water addition in gallons is determined by dividing the amount provided by the Chemistry Coordinator by 49 gal/inch. Process water is lined up to the AQW tank by opening valves H-262-SW-V-084, H-262-SW-V-087, and H-262-SW-V-088. Tank level is monitored while during the addition. H-262-SW-V-088 is closed and locked when the desired tank level is reached. The tank agitator is checked in operation, and started if not operating. The AQW transfer pump is then started to recirculate the required amount of time depending on tank level. Valves H-262-SW-V-084 and H-262-SW-V-087 are then closed. After recirculation, the contents of the tank is sampled and the sample results along with the tank level is recorded.

Transferring Waste to the AQW Tank

Prior to transferring any waste to the AQW Tank the nitrogen pressure in the AQW tank must be between LOW and HIGH-HIGH alarm setpoints. The level of the AQW Tank is then verified to be below the HIGH level alarm. The Spare tank is verified to have sufficient free volume to hold the contents of the AQW Tank after the transfer and no combustible gas can detected in the Incinerator or Tank Farm areas . All waste transfers to the AQW are conducted in accordance with the below listed procedures:

- 261-SOP-WTE-02, *Spare Tank Operations,* Section 4.6 Spare Tank Transfer to Aqueous Waste Tank
- 261-SOP-WTE-01, *Tank Farm Sump Operations,* Section 4.4 Transfer of the Clean Sump to the Aqueous Waste Tank and Section 4.6 Transfer of the Regulated Sump to the Aqueous Waste Tank
- 261-SOP-WTE-03, *Rad. Oils/Solvents Unloading Operations,* Section 4.5 Transfer to the Aqueous Waste Tank
- 261-SOP-WD-01, *Waste Drain Operations,* Section 4.5, Transfer of Building Sump Pump No. 1 to the Aqueous Waste Tank; Section 4.8, Transfer of Building Sump Pump No. 2 to the Aqueous Waste Tank; Section 4.11, Transfer of Building Sump Pump No. 3 to the Aqueous Waste Tank; Section 4.14, Transfer of Off Gas Sump to

the Aqueous Waste Tank; Section 4.17, Transfer of the Stack Sump to the Aqueous Waste Tank

AQW Transfer to the AQW Feed Pump

The procedure for transferring AQW to the AQW Feed Pump can be found in 262-SOP-AQW-01, *Aqueous Waste Operations*, Section 4.3 Establishing Aqueous Waste Tank recirculation to the Aqueous Waste Feed Pump. The maximum feed rate for low heat waste to the Rotary Kiln is 950 pounds per hour (114 gallons per hour).

The following conditions must exist prior to admitting aqueous waste to the RK:

- The incinerator is operating in Operation Mode 1, meaning that the Incineration system is allowed to receive solid and/or liquid wastes. The fuel oil burners are on, and the incineration system is above minimum temperature for incineration. The DCS should be in Alarm Mode 1 in Cold Standby. Minimum temperatures for hazardous aqueous waste materials are defined as RK exit temperature is at or above 1450°F and the SCC exit temperature is at or above 1600°F. Minimum RK temperature for injection of non-hazardous aqueous waste materials is 1200°F.
- Pilot and Main Shutoff Valves are closed and waste ,steam and propane pressures are within set limits.
- Atomizing steam is in service. Atomizing steam is admitted to the AQW nozzle when RK temperature reaches 1000°F to provide tip cooling.
- Btu content (≤ 5000 Btu) and specific gravity (≤ 1.05) of the AQW Tank contents does not exceed the maximum allowable.
- No transfers to or from the AQW Tank are in progress.
- Recirculation or processing of Aqueous Waste to the remote or local burner skids shall be stopped when a tank farm or rotary kiln area combustible gas detector or radiation detector alarms. Furthermore the explosive gas detectors associated with the Tank Farm and the RK are verified to be indicating and the readings are <30% lower flammable limit.(LFL).
- Verify the AQW tank pressure alarms are not alarming
- Ensure the AQW tank level is between 48 and 131 inches.
- Conduct a valve alignment of AQW System valves located on the remote ad local skids. The valve alignment is Attachment 3, *AQW Skids and Nozzle Valve Alignment* to the *Aqueous Waste Operations* procedure, 261-SOP-AQW-01.
- The pulsation dampener should be charged with nitrogen between 15 and 40 psig.
- The AQW tank agitator is operating
- AQW Transfer switch at DCS point tag WTE0519HS-1 selected to AQW Feed Pump
- Verify all air operated-valves providing flow to and from the AQW are closed using the DCS
- Start the AQW transfer pump from DCS point tag WTE0516E-1
- Record AQW tank level

- Set the AQW flow controller to 10% from DCS point tag AW2000FC-1 to start AQW feed at a minimum rate
- Ensure the AQW steam pressure controller is set for at least 110 psig at DCS point tag AW2008PC-1
- Start the AQW Feed pump and open the Safety Shutoff Valves from DCS point tag AW2016E-1, RK AQW FEED START/STOP switch
- After the DCS switch is actuated to start AQW flow verify the Safety shutoff valves open at point tags AW 2005HV-1 and AW2006HV-1
- Verify AQW ON status is indicated at DCS point tag BMS8004E-1,(WL/AQW/ROW Status), or from the "Aqueous Waste On" light on BMS-PNL-1513 panel indication status
- Gradually increase AQW feed rate to the desired rate using DCS flow controller at point tag AW2000FC-1
- Verify that AQW feed is less than 950 pounds per hour.
- The Aqueous Waste feed will always require modulation because the RK temperature controller INC1705TC-1 does not control this feed in automatic burner control. Close control of the temperatures, excess air, kiln speed, and gas flow rates in the rotary kiln and SCC is required to maintain adequate residence time and assure complete combustion.

AQW Transfer to the Blend Tanks

Upon direction of the SS to transfer AQW to a Blend Tank the following conditions are verified:

- Compatibility of the AQW Tank contents with Blend contents has been verified by the Chemistry Coordinator.
- Ensure the combustible gas detectors associated with the tank farm are operating and indicating < 30% LFL
- Ensure the air monitor detectors associated with the tank farm are operating and there are no alarms
- Ensure the Blended Waste System has been aligned in accordance with 261-SOP-BRW-01
- Determine the available volume in the Blend Tank as follows:

Subtract the maximum operating level (133 inches) from the current level. Multiply this answer by 31.33 gal/inch to determine the available volume in gallons.

- Determine the volume of liquid to be transferred from the AQW tank as follows:

Using the available volume in gallons from the blend tank calculation above, divide this value by 49 gal/inch to solve for inches from the AQW tank to be transferred to the blend tank. Multiply this value by the specific gravity of the AQW contents (8.34 lbs/gal) to determine the number of pounds to be transferred. This is the value used in the AQW transfer controller setpoint.

- Ensure the AQW tank agitator is operating
- Check closed valve H-262-WTE-V-097, AQW tank recirculation to Feed Pump valve.
- Verify using point tag displays all air-operated flow control valves from the AQW tank closed.
- Record the current Blend tank level prior to transfer
- Reset the AQW transfer flow totalizer and enter the pounds to be transferred into the transfer controller
- Select the proper blend tank with the DCS AQW transfer switch
- Start the AQW transfer pump from point tag WTE0516E-1
- Determine expected AQW transfer time as follows:

Divide the number of pounds to be transferred by the current flow rate in pounds as indicated on DCS point tag WTE0517F-1.

- Verify that the AQW tank level is lowering and the Blend tank level is rising, and the opposite Blend Tank and Spare tank levels are not changing.
- Check for leaks at the at the Rad. Oils/Solvents Unloading area and the Tank Farm diked area
- When the AQW transfer flow totalizer equals the setpoint ensure the flow control valve to the selected Blend Tank shuts using DCS indication.
- Determine the expected increase in Blend Tank level as follows:
- Subtract the current AQW tank level from the AQW level prior to transfer. Multiply this level in *inches*, by 49 *gal /inch.* The result is the number of gallons transferred. Divide the number of gallons by 31.33 *gal/inch* to determine the expected increase in inches of the Blend Tank. Add this level to the Blend tank level prior to transfer to determine expected Blend Tank level after transfer. Compare the expected tank level to the current level. Resolve any differences >1.0 inch.

AQW Transfer to the Spare Tank

Upon direction of the SS to transfer AQW to the Spare Tank the following conditions are verified:

- Compatibility of the AQW Tank contents with Blend contents has been verified by the Chemistry Coordinator.
- Ensure the combustible gas detectors associated with the tank farm are operating and indicating < 30% LFL
- Ensure the air monitor detectors associated with the tank farm are operating and there are no alarms
- Ensure the Spare Tank System has been aligned in accordance with 261-SOP-WTE-02
- When transferring the AQW contents to the Spare tank, the available level in the Spare Tank shall be reduced by the level in either Blend Tank (whichever is higher). In case

of a leak in either Blend tank the Spare Tank shall have spare capacity to accept transfer from either blend tank.

- Record current Blend Tank levels
- Determine the Spare Tank equivalent inches required to accept a transfer from a blend tank as follows:

Multiply the level in the fullest blend tank by 31.33 gal/inch. This solves for the number of gallons in the blend tank. Divide the number of gallons of the fullest blend tank by 49 gal/inch to determine the equivalent spare tank level. This number is the spare capacity that must be maintained to accept the contents of a blend tank.

- Determine the available volume in the Spare tank to accept an AQW tank transfer as follows.

Subtract from the maximum operating spare tank level (130 inches), the current spare tank level and subtract the spare capacity as determined in the above calculation. The answer is the available level left for AQW transfer.

- Determine the volume of liquid to be transferred from the AQW tank as follows:

Subtract the current available spare tank level from the current AQW tank level. This will give the amount the AQW tank level will be lowered. Multiply this level in inches by 49 gal/inch to determine the number of gallons transferred and multiply the number of gallons by the AQW tank specific gravity and multiply this value by 8.34 lbs per gallon to determine pounds to be transferred.

- Ensure the AQW tank agitator is operating
- Check closed valve H-262-WTE-V-097, AQW tank recirculation to Feed Pump valve.
- Verify using point tag displays all air-operated flow control valves from the AQW tank closed.
- Select the Spare tank with the DCS AQW transfer switch at point tag WTE0519HS-1
- Reset the AQW transfer flow totalizer and enter the pounds to be transferred into the transfer controller at point tag WTE0517F-1
- Verify that AQW to Spare Tank transfer valve H-262-WTE-FV-0530 is open using point tag WTE0530HV-1
- Ensure the AQW transfer pump is operating or start it from point tag WTE0516E-1
- Determine the expected transfer time using
- Start the AQW transfer pump from point tag WTE0516E-1
- Determine expected AQW transfer time as follows:

Divide the number of pounds to be transferred by the current flow rate in pounds as indicated on DCS point tag WTE0517F-1.

- Verify the AQW tank level is lowering and the Spare tank level is rising
- Verify that the Blend Tank levels are not changing

- Check for leaks at the Rad. Oils/Solvents Unloading Area and the Tank Farm Diked Area
- Ensure that the AQW to Spare Tank transfer valve shuts when the totalizer reaches the setpoint entered into the flow controller.
- Ensure the AQW transfer pump is not operating
- Determine the expected increase in Spare Tank level as follows:

Subtract current AQW tank level from initial AQW tank level prior to transfer. This determines the number of inches transferred. Add this value to the initial level of the Spare Tank prior to transfer to determine expected Spare Tank level. Compare the expected Spare Tank level to the current Spare Tank level. Resolve any differences of > 1.0 inch.

Abnormal Operations

Abnormal operations of the AQW System include all events that are not performed on a regular basis, and do not imply "something is wrong."

Abnormal Events

Performance of 261-AOP-WTE-01, *Tank Farm Events* can be directed by an Emergency Operating Procedure, Alarm Response Procedure, Abnormal Operating Procedure, OR by observation of the following.

- Leakage from a tank, line or component

  If a liquid waste release has occurred as a result of any equipment failure, action should be taken as directed by 261-EOP-03, *Low Energy Liquid Release*.

- **Tank vent or loop seal failure**

  If a tank vent or loop seal system has failed, stop all transfers to the affected tank until repairs can be made.

- **Sampling Failure**

  If liquid sampling system has failed, stop all liquid transfers to the affected tank until repairs can be made.

- **Fire Suppression Failure**

  If the Fire Suppression System has failed initiate fire watch and report the failure to the fire department. Depending on what failed, a process shutdown from Normal Operations to Warm Standby, may be necessary.

- **Tank Farm Instrumentation Failure**

  If a loss of tank level or pressure instrumentation has occurred, shut down all transfers to or from the affected tank until repairs can be made.

- **Temperature Alarms**

If a high tank temperature alarm is received, stop the tank agitator and any operating tank pump. A tank temperature rise of >10°F requires determination of an exothermic chemical reaction by the Chemistry Coordinator. If an exothermic chemical reaction is responsible for tank heat up, then evacuate the Tank Farm and notify the Shift Supervisor.

A Low AQW Tank Temperature alarm has no automatic functions and can be caused by an idle AQW tank with extreme outside temperatures. The necessary actions would be to energize the Heat Trace System and operate the tank agitator since no heaters are installed in the AQW Tank.

A Low RK AQW Temperature alarm has no automatic functions and the heat trace system must be investigated to ensure that it is energized. Failure of the heat tracing to the AQW feed piping may cause a low AQW temperature alarm during extreme temperature conditions.

- **Tank Agitator Failure**

If a tank agitator fails, shut down transfers to or from the AQW Tank until repairs can be made.

- **Tank Corrosion**

If a Tank Corrosion probe alarm is received no automatic functions will occur. Probable causes are from corrosive chemical batch or loop failure. Stop transfers into the effected tank and sample the tank. Investigation of the alarm is necessary and emptying/flushing the AQW Tank to curtail corrosion may be required.

- **Tank Pressure alarms**

A High AQW tank nitrogen pressure will automatically inhibit the following:

- Stops the AQW Tank Agitator
- Stops the AQW Transfer Pump
- Stops the Rad/Oils/Solvents Unloading Pump
- Shuts H-262-WTE-FV-0510, unloading pump to AQW Tank valve
- Shuts H-262-WTE-FV-0511, building sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0522, regulated sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0523, clean sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0528, Spare Tank to AQW tank valve
- Shuts H-262-WTE-FV-0530, AQW Tank to spare tank valve

The alarm must be investigated by an operator. This alarm can be caused by a chemical reaction in the tank so the tank temperature must also be checked. Additional causes of a high pressure may include a failure of the nitrogen supply regulator or a stuck shut conservation vent disc. If tank temperature is not high, ensure all liquid transfers have

stopped and determine the cause for high pressure (clogged vent filter, vent line or vent line valve out of position).

If a tank pressure is low, stop all liquid transfers out of the affected tank and investigate the Nitrogen System. A low nitrogen pressure alarm will automatically inhibit the following:

- Stops the AQW Tank Agitator
- Stops the AQW Transfer Pump
- Stops the Rad/Oils/Solvents Unloading Pump
- Shuts H-262-WTE-FV-0510, unloading pump to AQW tank valve
- Shuts H-262-WTE-FV-0511, building sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0522, regulated sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0523, clean sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0528, Spare Tank to AQW tank valve
- Shuts H-262-WTE-FV-0530, AQW Tank to spare tank valve

- **Rupture Disk Alarm**

A rupture disk bursting will actuate a High-High AQW tank nitrogen pressure alarm at 1.5 psig. Actuation of this alarm will inhibit the following:

- Stop the AQW Tank Agitator
- Stop the AQW Transfer Pump
- Stop the Rad/Oils/Solvents Unloading Pump
- Shuts H-262-WTE-FV-0510, unloading pump to AQW tank valve
- Shuts H-262-WTE-FV-0511, building sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0522, regulated sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0523, clean sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0528, Spare Tank to AQW tank valve
- Shuts H-262-WTE-FV-0530, AQW Tank to spare tank valve

- **Level Alarms**

A High-High High level alarm on the AQW tank can be caused by excessive transfers into the Aqueous Waste Tank. Actuation of this alarm will automatically inhibit the following:

- Shuts H-262-WTE-FV-0510, unloading pump to AQW Tank valve
- Shuts H-262-WTE-FV-0511, building sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0522, regulated sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0523, clean sump pump to AQW tank valve
- Shuts H-262-WTE-FV-0528, Spare Tank to AQW tank valve

A High-level alarm on the AQW Tank does not cause automatic functions other than the alarm. Investigation of the alarm is necessary, and if level continues to rise, shutting of all valves that provide an input flow to the tank will be necessary.

A Low-level alarm on the AQW Tank does not cause any automatic functions other than the alarm. Investigation of the alarm is necessary, and if level continues to lower, then stop the AQW Tank Agitator.

A Low-Low level alarm on the AQW tank will automatically apply a hold to the level loop multiplier. The level loop multiplier supplies density correction to compute tank level. The density of the tank contents will be held at the value detected at the Low-Low level alarm and will remain locked until level rises above the Low-Low level point.

A Low-Low-Low level alarm can be caused by a leak in the tank or higher than expected transfer rates. Actuation of the alarm will automatically inhibit the following

- Stops H-262-WTE-AGT-0501, AQW Tank Agitator
- Stops H-261-AQW-P-2055, AQW Feed Pump
- Stops H-262-WTE-P-0516, AQW Transfer Pump

- **AQW Pressure Alarms**

A low RK AQW Pressure alarm has no automatic functions. The alarm must be investigated and the DCS flow controller placed in manual to raise the feed pressure. Possible cause of the alarm may be a failure of the AQW Feed pump back pressure regulator, low discharge pressure from the AQW feed pump, or stuck open AQW feed pump discharge pressure relief valve.

A Low-Low RK AQW Pressure alarm will automatically stop the AQW Feed Pump, and the alarm must be investigated. Possible cause of the alarm may be a failure of the AQW Feed Pump backpressure regulator, low discharge pressure from the AQW Feed Pump, or a stuck open AQW Feed Pump discharge pressure relief valve.

A High RK AQW Pressure alarm has no automatic functions. The alarm must be investigated and the DCS Flow Controller must be placed in MANUAL to lower feed pressure. The high pressure condition can be caused by failure of the AQW feed backpressure regulator valve or the discharge pressure relief valve failing closed.

A High RK AQW Differential Pressure alarm does not have any automatic functions. The alarm must be investigated to determine if the filter needs to be serviced . The alarm can be caused by flow restriction in the AQW Feed Pump suction filter.

- **Flow Alarms**

A High RK AQW Flow alarm will automatically stop the AQW waste flow. A Mandatory Incinerator Shutdown must be initiated if waste feed cutoff did not occur. The alarm must be investigated and verified. The possible causes of the alarm can be from failure of the DCS flow controller, Aqueous Waste Feed Pump, Mass Flow Element or Back Pressure Control

Valve.

A Low RK AQW Steam Flow alarm has no automatic functions. The alarm must be investigated and the Medium steam DCS controller placed in MANUAL to raise steam flow. Failure of Medium steam pressure controller, steam to incinerator pressure control valve, or loss of supply steam may be possible causes of the alarm.

A High RK AQW Bypass Flow alarm does not have any automatic functions. The alarm must be investigated . The alarm can be caused due to flow restrictions in the discharge of the AQW Feed Pump.

- **Steam Pressure Alarms**

A Low RK AQW Steam Pressure alarm has no automatic functions. The alarm must be investigated and the Medium steam DCS pressure controller placed in MANUAL to raise steam pressure. Failure of Medium steam pressure controller, steam to incinerator pressure control valve, or loss of supply steam may be possible causes for the alarm.

A Low-Low AQW Steam Pressure alarm will automatically stop the AQW Feed Pump. The alarm must be investigated and the Medium steam DCS pressure controller placed in MANUAL to raise steam pressure. Failure of the Medium steam pressure controller, steam to incinerator pressure control valve, or loss of supply steam may be possible causes for the alarm.

A High RK AQW Steam Pressure alarm has no automatic functions. The alarm must be investigated and the Medium Steam DCS controller placed in MANUAL to control steam pressure. Failure of the Medium steam DCS pressure controller or steam to pressure control valve may be a cause for this alarm.

- **AQW Nozzle Alarm**

A RK AQW Gun Out-of-Position alarm will automatically stop the AQW Feed Pump. The alarm must be investigated. The probable cause of the alarm will be mechanical shock to the nozzle causing misalignment.